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SEWAGE TREATMENT VS. SEWAGE PURIFICATION.

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The art of sewage purification has been making progress during recent years. Of this there is no doubt. The nature of the advance, however, has not been that which the popular mind believes it to have been. It has not been in the direction of making sewage more nearly resemble drinking water so much as it has been in adjusting the treatment to particular needs, making the treated sewage fit for discharge into some particular stream or lake, taking into account the subsequent use of this water. The greatest progress has not been in obtaining a higher degree of purity for sewage effluents, but rather in the invention of methods and devices applicable to conditions not previously encountered. To illustrate: the general results of that notable series of experiments made a quarter of a century ago by the Massachusetts State Board of Health at Lawrence was that the application of sewage to land according to the method known as intermittent sand filtration was the one best suited to the local conditions of that state. Time has proved that this conclusion was correct, and the plants that have been constructed have on the whole given satisfactory results. Intermittent sand filtration gives a relatively high degree of bacterial efficiency. But sandy soils of the proper character do not exist everywhere in the United States; they do not exist in England. Large areas are required and it is not often that these can be found at the proper elevation near large cities. Therefore, this excellent method of sewage purification is much limited in its application. The need of processes to fit other conditions led to the use of improved screens, of chemical precipitation works, of septic tanks, of sprinkling filters, of contact beds, processes excellent in their way, but as ordinarily operated not capable of purifying the sewage to the same extent as the older method of treatment on land. Yet, and this is the point of my paper, these miscellaneous processes all go popularly under the name "sewage purification plants." In a certain

sense this is correct, for they contribute to the removal of the objectionable ingredients and living organisms in the sewage. The sanitary engineer, knowing the nature of the results, makes a proper mental discount of the term and is not deceived. The layman, however, takes the word "purification" at its face value and is deceived. How many times do we hear city officials proudly boast that the sewage of their city is in no way dangerous because it is purified in a septic tank, when it would seem that the use of one's nose and the application of a little common sense would lead to a different conclusion!

There is no more fatal error in logic than failure to properly define the premises; nothing contributes so much to controversy and misunderstanding as the use of terms of uncertain meaning. The speaker believes that much of the prevailing discussion with respect to the advisability of adopting this or that method of guarding water supplies against infection, and of preserving the quality of the water in our waterways has been confused in the minds of many on account of the use of the term "sewage purification" to cover methods and processes that do not make the sewage pure.

It is gratifying to observe that there is an increasing tendency among sanitary engineers to substitute for the term "sewage purification" the words "sewage treatment." Notably Mr. George W. Fuller has adopted this language in his recent admirable treatise on sewage disposal. It is to be hoped that its use will become general. If not, the term "sewage purification" will inevitably become degraded as people come to learn, as they must, that not all so-called purification plants really purify the sewage. The term "sewage treatment" does not imply complete purification and is, therefore, the more general and the better term.

Using the words in their most obvious meaning, let us ask the question, ought the sewage of our American cities to be purified? Generally speaking, no. To do so would be enormously expensive, and in most cases the results accomplished would not be commensurate with the cost. Ought the sewage of our American cities to be treated in some way before being discharged? Generally speaking, yes. There are relatively few instances where raw sewage can be discharged into streams or lakes without causing objectionable local conditions or dangers of a sanitary character. The nature of the treatment required will vary all the way from a mere straining out of the grosser solids to a combination of processes that results in actual purification.

We hear it said that in England practically all of the sewage is purified. Is this true? Yes, if it is meant that the sewage is submitted to some process that improves its character; but no, if it is meant that these processes completely remove the organic matter and free the sewage of its dangerous bacteria. For example, we like to refer to the interesting sewage works at Manchester and Salford with their great septic tanks and contact beds

and sprinkling filters, and we speak of them as purification plants. Do we realize, however, that analyses of the sewage effluents show that during a large part of the time they fall below the standard of purity established by the Mersey and Irwell Joint Committee, a standard that cannot be regarded as too strict if we maintain a reasonable meaning of the word "pure." The biennial report of Hugh Stowell, chief inspector for the Mersey and Irwell district, dated May, 1912, states that out of 126 sewage works 23 per cent were non-efficient, this being an improvement over 34 per cent as shown by his previous report. At Manchester 22 per cent of the samples were below the established limit for organic matter of "one grain of oxygen absorbed per Imperial gallon in four hours," at Salford 12.8 per cent of the samples were below standard. This is not intended as a criticism of English methods of treatment, which, on the whole, are well adapted to their particular needs, but merely to illustrate the danger of using loose phraseology.

Or to take another illustration, can the water supplies of our lakes be protected by purifying the sewage that enters them? Many laymen think so, and ardently advocate the construction of sewage purification plants and oppose water filtration. Would they say the same if they realized that most so-called sewage purification plants only partially remove the dangerous substances from the sewage, and that complete removal is impracticable on account of the expense and the almost insuperable difficulty of treating all of the sewage at times of storm. Would not these well-meaning people have a clearer conception of the problem if instead of using the broad misleading word "purification," we used the term "sewage treatment," or still better, some term that described definitely the results accomplished by the different processes.

With laws being framed in various states to control the pollution of rivers and waterways, it is high time that popular misconceptions should be corrected and that the different phases of this complicated problem should be made clear. In the first place, it should be more definitely understood that in the treatment of sewage there are two very different functions to be considered. One is to get rid of the foul, putrescible matter with its accompanying offensive smell; the other is to get rid of living, disease-producing organisms. One is very largely a physical and biochemical problem; the other is chiefly bacteriological. One does not directly concern the public health; the other may. In practice, these functions overlap but they may be kept separate.

Is it not the popular conception of the function of sewage disposal plants that they are intended primarily to protect the public health? Is not this the theory upon which some of the recent legislation is based? It certainly appears so. But is this idea correct? Does the treatment of sewage by the ordinary process materially improve the public health? Are sewage works

a success from the hygienic point of view? It is a vital question and one that has not been sufficiently considered from the standpoint of cost and result.

Sanitary history has shown that when polluted water supplies have been purified by filtration, the typhoid fever death rate of the community has lessened and the public health has otherwise materially improved. And it is a matter of easy reckoning to tell that the financia' benefits represented by the saving of human lives and the prevention of sickness have far exceeded the cost of filtration. Taking the cost of efficient water purification at $10 per million gallons and allowing a per capita water consumption of 100 gallons per day, the process pays for itself if it reduces the typhoid fever death rate by 4 per 100,000.

No such record can be shown for the purification of sewage, except, perhaps, in the case of a few small plants built for the protection of the water supply of some large city, and even here it is difficult to measure the number of lives that have been saved. The complete diversion of sewage from the drainage area of a public water supply has repeatedly been of hygienic benefit. So has the introduction of sewer systems in cities and towns where none existed before. But the so-called purification plants that have been constructed for the large cities of the world have not the saving of many human lives to their credit, so far as the best available evidence shows. The reason is obvious. They have not, as a rule, been built for that purpose, popular ideas to the contrary notwithstanding.

Sanitarians abroad have long recognized the fact that river water supplies cannot be protected against the danger of infection by any of the known methods of treating sewage discharged into the river above the water works intake. Instead they depend upon the filtration of the water supplies themselves. In Germany the filtration of surface water supplies is required by law and no difficulty has been found in building water filtration plants capable of purifying water after it has received what would be regarded in this country as a large amount of sewage. In Germany and in England sewage disposal works are built primarily to remove organic matter and prevent streams from becoming foul. Therefore, when public health authorities in this country compel large cities to construct sewage treatment plants for the avowed purpose of protecting water supplies taken from rivers below them, they are attempting to accomplish the impracticable, and are compelling the expenditure of money without adequate returns. The most that can be expected in this direction is to lessen the burden placed upon the water filters. In some instances this may be desirable and necessary, for water filtration plants, like all other mechanisms, sometimes fall short of their best performance, and it is only reasonable to allow a certain factor of safety.

The pollution of water supplies is not the only thing involved in this

matter. Sometimes it is a question of protecting shell-fish supplies, or of bettering the sanitary condition of the water at bathing beaches. These may be fairly classed among the direct sanitary benefits of sewage treatment, but here the treatment to be of benefit must be quite complete and, therefore, expensive, while the number of lives saved in this way is probably small.

It would not be right to balance the cost of sewage purification against the saving of human lives were it not for the fact that our cities are subject to debt limits and that money is needed for many other purposes that affect the public health: for cleaner streets, for better care of schoolhouses, for parks and playgrounds, and for the special needs of the Department of Health in securing safer milk and food supplies, and for all sorts of hygienic and sanitary inspections. In view of the steadily increasing tax rates in our large cities, it behooves sanitarians to find out for each city in what direction money allotted to the saving of human lives will do the most good. In other words how can the most lives be saved for a dollar? Whatever the answer may be, it is not likely to be found in the purification of sewage.

That the sewage of most American cities should be subjected to some form of treatment is conceded. The need will increase as our cities increase in size and number. The problem at hand is to determine the most appropriate treatment for each case, bearing in mind the results that can be accomplished, the peculiar local condition, and the cost of construction, maintenance, depreciation and operation.

Processes of treatment perform one or more of these functions: clarification of the sewage, oxidation of the organic matter and removal of bacteria. The effect of the methods of treatment now available and in common use are given by Fuller in his treatise already referred to as follows:

Method	Percentage Purification		
	Suspended Matter	Organic Matter	Bacteria
Fine screens (30 mesh or finer)	15	10	15
Sedimentation	65	30	65
Septic treatment	65	30	65
Chemical precipitation	85	50	85
Contract filters*	85–90	65–70	80–85
Sprinkling filters*	85–90	65–70	90–95
Intermittent sand filters *	95–99	90–98	98–99

* The figures for the last three forms of treatment are on the assumption that the sewage is given some form of preparatory treatment before it is applied to the filters, and that with the sprinkling filters the effluent is allowed to settle.

It is evident that some of the processes that are used primarily to prevent sewage from producing foul conditions, do also remove many bacteria, and to the extent that they do this they improve the sanitary quality of the treated sewage. Often this can be accomplished at low cost, while to effect a reasonably complete and useful bacterial removal would very greatly add to the expense. This treatment of sewage to a less degree than that of complete sanitary purification may pay, even though the direct hygiene aspects of the case be ignored, for whatever eliminates public nuisances adds to the comfort of the people at large, and tends to restore depreciated real estate values.

The above ideas are not new to sanitary engineers; they know the limitations of the various methods of treatment; they know how well they work when kept in order, and how grievously they fail when not properly operated and enlarged as need requires; they are able to determine what methods or combination of methods are best suited to any case. Yet in common parlance and in official reports they continue to say "sewage purification" when they mean something less. Perhaps a better term than "sewage treatment" can be found, but let us at least be more particular in the use of terms describing the processes discussed, lest the cause of sanitation suffers a reaction from the over-zealous interest of laymen based on false conceptions.

DISCUSSION.

MR. RUDOLPH HERING, *New York City:*

Mr. Whipple's paper touches a very important subject, so far as our general public is concerned. It is very timely to call attention to the inclination to use the word "purification" when we mean only some treatment of sewage.

There are but few persons, outside of those engaged in this subject, that have a clear idea of the difference between sewage treatment and purification, believing generally that any work for treatment means one which effects purification. Indeed, outside of very carefully conducted intermittent sand filtration works, it is a question whether sewage is really purified by any of the ordinary treatment plants, unless we consider that a long flow in a water course ultimately purifies sewage.

Mr. Whipple emphasizes the correct and sound view, not generally held, that sewage should in any case not be purified further than economical considerations justify, and also the fact which is gradually being recognized, that even where domestic sewage discharged into rivers has been highly purified, it is still necessary to purify any water supplies taken from such rivers.

Too much emphasis cannot be given to the fact that our communities have only those amounts of money to spend for sanitary improvements which can be raised by taxation, and that there are many purposes for which expenditures are necessary. Sewage purification is but one of them. The citizens of a community must first be clear as to the amounts of money they will spend for each of the various different sanitary purposes, and then secure the best results which can be had for the money that is available.

Of course a subsequent closer study of these subjects might change first impressions. Therefore, where there is any doubt, a most careful study should be made by competent parties, to proportion the expenditures so that the public health will be most properly served.

These conclusions cannot be better stated than in Mr. Whipple's own words, which could not at this time be too often repeated: "In view of the steadily increasing tax rates in our large cities it behooves sanitarians to find out for each city in which direction money allotted to the saving of human lives will do the most good. In other words, how can the most lives be saved for a dollar."

The paper suggests another subject which is too often misunderstood, namely, the removal of bacteria from sewerage effluents.

Now, when we recognize the fact that a large amount of sewage purification is accomplished by bacterial activity, we should not consider it an unmixed advantage to remove bacteria from a polluted water. We might add hypochlorite of lime to the water and destroy practically all bacteria and all putrefaction. Would the sewage then have been purified? By no means. Within a few days, if not hours, the same water might again putrefy.

We should rather endeavor to create conditions which increase the number of bacteria which do the purifying, until the desired degree of purification has been effected, and when, there being no further food for the bacteria, their extinction is a natural consequence.

Having this desirable result in view, we must, on the other hand, not overlook the equally desirable result of creating conditions which extinguish all bacteria that are pathogenic. Fortunately, most of the latter do not thrive outside of organic bodies and have also other favorable qualities, which in the future may make it possible to facilitate their destruction, without also destroying the bacteria which are necessary for sewage purification.

DR. JOHN A. AMYOT, *Toronto:*

It is too frequently not realized that sewerage and sewage treatment are two different things. The costs are usually given out combined. The cost of a treatment plant and afterwards maintenance is only a small percentage of the general cost. It is from this that sewage treatment is so often erroneously put down as being prohibitive in cost. It costs more to maintain the sewers of a city than to maintain a treatment plant. The sewers cost many times more than a treatment plant. The time has come when cities must keep as clean as individuals and must not any more than individuals dirty other people's property. The most important thing for cities now to remember is that their sewage is a disease-carrying material, and that the time has come when other people must not be caused to suffer because they want the modern comforts and safety of city life. They must pay for it. They pay high for other things, why squeal at this one.

MR. F. HERBERT SNOW, *Harrisburg, Pa.:*

I am not sure whether I understand the position which Professor Whipple takes with respect to the importance of treating sewage before the effluent is discharged into a body of water—particularly running water used subsequently as a source of public water supply. If he means to be understood as maintaining the position that there are few situations where the necessity exists for the treatment of the sewage in those cases where further down the stream the water is used as a source of filtered supply to the public, then I beg to differ with him in opinion.

We have had a number of striking illustrations in Pennsylvania of the failure of water filter plants to properly purify sewage polluted waters before they are supplied for drinking purposes to the citizens of the town. Ordinarily, water may be purified sufficiently to render it safe and wholesome, but occasionally the filters may be overtaxed, accidents may occur, or carelessness in operation may obtain, resulting in the admission to the public system in the town of water containing sewage organisms, followed by increased typhoid fever among the consumers. These cases emphasize the importance of controlling the pollution of the water at the point when the pollution occurs.

I am perfectly well aware of the fact that if the water purification plant be operated efficiently, if skilled attendants be provided, if the plant be ample in size and no lapse in faithful management occurs and if no accidents happen, a very high degree of protection is afforded at such water purification plant.

Furthermore, I am willing to agree that of the two safeguards to public health, namely, treatment of the sewage in the first place and the subsequent purification of the river water in the second place, the latter is more essential and that it is the proper place at which attention should be bestowed primarily.

The introduction of filtration works to render a suspicious source of supply pure and wholesome is quite frequently attended with a reduction in typhoid and other water-borne diseases 75 per cent. or more. I do not wish to minimize the importance, but would urge the necessity for the proper filtration and purification of all source of water supplies subject to much organic contamination. But I insist that it is essential in protecting public health to put up all reasonable barriers to the transmission of infection into the homes of the water consumers.

I base my conclusions upon extended experience and principally from observation as to the origin and transmission of typhoid infection and the consequent spread of disease in the town, due to contamination of public drinking water.

Because the protective value to public health by the water filter plant is so frequently and strikingly demonstrated in the drop of typhoid fever immediately following the installation of the water filter plant, and because there is no corresponding drop when sewage treatment works are built, one might form the conclusion that treatment of sewage does not bear an important relation to public health in the protection of public water supplies. I think sanitarians, and particularly the sanitary engineers, should be very cautious in their statements delivered to the public regarding this matter.

I did not know before yesterday, not having come in contact with it in my work, that in some places the public officials seem to think that the erection and maintenance of sewage treatment works is a sufficient protection in itself to the public water supply, and that of the two, the sewage treatment or the water treatment, these officials seemed satisfied to accept sewage treatment as sufficient. I do not want any doubt to exist in any one's mind as to the position which I take on this subject. Water filtration is the more important. The point where I apparently differ with Professor Whipple is that he, if I understand it correctly, minimizes the importance of sewage treatment in the protection of public water supplies to a degree that I cannot sustain. If this is an erroneous view, I shall be very glad to be corrected.

In considering this subject briefly, we may take up first the mountainous unpopulated watershed where the areas yield pure brook and spring waters that are contaminated, if ever, to a slight degree only and by accident. Even such waters may be infected and result in widespread sickness and death in the town miles away, as amply illustrated in a number of cases in Pennsylvania. But the circumstances in this class of watershed do not warrant the compulsory installation of water filtration plants, or the construction of impounding reservoirs as a barrier to transmission of infection into the town where the volume of flow in the stream is sufficient for public purposes. If industrial camps or other temporary occupations of the watershed occur, they should be under the supervision and sanitary regulation of some authority. In Pennsylvania, municipalities and corporations securing their supply from such areas, are required to maintain proper sanitary patrol.

We then come to the upland watershed sparsely populated. Here the area may be largely wooded with an occasional farmstead noted. There are many areas in Pennsylvania averaging about twenty-five inhabitants per square mile from which the waters yielded are impounded and supplied to the public beyond for drinking purposes. No sewers exist on these watersheds and no industries with their wastes to defile the streams. The pollutions when they occur come from fertilization of the soil and from the improper disposal of wastes at the dwelling or barn-yard. A sanitary survey of the watershed and the maintenance of proper standards of sanitation at the farmstead is sufficient, plus the barrier which the impounding of waters affords to the transmission of infection, to safeguard the health of the consumers of this water in the town in a large number of instances. The prompt reporting of all contagious and infectious diseases among these rural inhabitants, the proper disposal of the wastes on the

watershed and the systematic inspection of all occupied estates is considered sufficient. In both of these classes of watersheds attention to the disposal of the sewage is of primary importance.

Now then, we come to the next kind of watershed. The population is more. It will range up to as high as one hundred and twenty-five inhabitants per square mile. On this area, villages will be found and foci of infection will exist which increases the liability to organic pollution of the waters of the streams to such a degree as to menace public health in a town relying for drinking water upon the streams from such areas, and in consequence additional precautions beyond that of sanitary inspections and proper disposal of sewage at the household are necessary. A large impounding reservoir or the addition of a germicide to the water before sending it into the town, or the installation of a water filtration plant are the safeguards. It may be sufficient to rely upon the impounding factor, plus the use of a germicide; or, after this is tried, it may be found that there is still too much of an element of risk to public health. If so, then the filter may be added; but before this is done you see the attention to proper disposal of the sewage at the dwellings has been a primary factor.

Now then, we come to another kind of watershed; one upon which large villages or small towns or boroughs exist, having public water supplies and sewer systems or upon which large industries are located, the wastes of which contaminate the water of the creek or river. Here it is quite possible that no amount of treatment of the sewage from the sewer system will protect the purity of the waters of the stream to a degree rendering them suitable to use without treatment in a water filtration plant and it is in such a case as this, as I understand it, that the point is debatable as to whether any attention should be bestowed upon the treatment of the sewage.

We must not overlook the fact of the legal rights existing in public waters and the sanitary engineer must be governed to a large extent in his views and conclusions by the demands of the rights vested in landowners through whose property living streams of water flow. No one under common law has a right to defile a stream to such an extent as to render the waters impure or unsuitable for common use below. But in practice the courts have had to modify their views and decisions to fit into changing conditions that are beyond the control of human agency. For instance, there is a natural pollution of a river incident with the gathering of people in great numbers upon small areas which is a nonpreventable and therefore, in one sense, a legal pollution of the waters. The wash from streets of the city is sewage. It may not contain as many pathogenic organisms as the sewage discharged into the river from the sewer, but at the same time such surface drainage contaminates a water and renders it unsuitable for drinking purposes without purification. And so there are numerous cases where attention to the treatment of the sewage flowing from the sewers of the town would not assure a standard of drinking water demanded in the interests of public health.

Furthermore, industries become important over large areas, including several counties, and the accompanying contamination of the waters of the region by these industrial activities being unavoidable, has resulted in the enactment of law that this peculiar contamination (and I have in mind now drainage from coal mining operations in the great anthracite and bituminous coal fields of Pennsylvania) shall be permitted without hindrance. Individuals have appealed from this law to the courts, demanding the protection of their property rights as higher than any legislative enactment, and the courts have determined that this great coal resource must be developed for the uses of the country, and that incident to this development a pollution of the waters of the district occurs that cannot be prevented and hence it is good public policy to accept and permit the mineral contamination of public waters in the coal fields even though it does deprive all riparian owners of the use of the stream in so far as purity and potability of the waters are concerned.

Riparian rights to the purity of waters are to be protected. They may be interfered with to some extent by decisions of the courts and by statutory regulations, and there may be

remedies at law for this interference, but when it comes to matters pertaining to public health, the sanitary engineer should consider that no situation can remain that tolerates the poisoning of a source of water supply to the extent to be a menace to public health. An individual caught putting prussic acid into the town reservoir would be summarily dealt with, and an individual caught infecting a town reservoir with typhoid dejecta would also be summarily dealt with and he would be committing a crime whether it were intentional or not.

From the health standpoint we are fighting the invasion of an enemy, powerful and insidious and that advances upon civilization along many avenues. The science of this warfare demands the erection of as many barriers to this invasion as are practicable. Surely one barrier only is not sufficient. All along the avenues of approach should attempts be made to stop the enemy. The point that I emphasize is that if Doctor Dixon's slogan, "kill the germ in the bed-pan" could be applied at the bed-side of every typhoid fever patient, and there were no such thing as typhoid carriers, the disease of typhoid could be stamped out immediately in the country and there would then be no necessity for the water filter plant so far as removing the typhoid germ is concerned from the water, because the germ would not be in the water.

Is there anyone who would argue against the killing of the germ in the bed-pan if this were possible? Does anyone argue even now against the regulation compelling nurses in the hospitals and compelling nurses in the homes of patients and of urging the necesssity upon all those who attend cases of typhoid fever, to disinfect thoroughly the discharges of the patient with the object of killing the infection there in the sick-room? No! There is not a man of us who does not subscribe to this principle of warfare against the enemy, and it is only because this operation in the sick-room is neglected or carelessly performed that so much of this pathogenic contamination gets beyond the dwelling and into the water supplies and the food supplies of the country, and maintains the high rate of cases and deaths throughout our land.

Very well, the next best place to kill the germ before it gets out of the town is at the mouth of the sewer. There are methods of disinfection that are inexpensive to apply first as to installation and as to cost of operation thereafter, by which not all of the germs may be killed but by which a large proportion of them will be destroyed; thus reducing the danger of widespread dissemination of the disease.

It may not be necessary in this warfare against the germ to erect extensive and costly sewage works to purify the sewage to a standard of nitrification; the refinement in purification can be accomplished farther down stream at the water purification plant; but I would emphasize the importance of destroying as much of the enemy's power as practicable by the treating of the sewage at the mouth of the sewer in the manner described.

We have heard it said that attention to the environment is not necessary or important and besides it costs too much; that it is cheaper to direct attention to water filtration. Now I believe that the methods I am now advocating are not costly, nor impracticable; but that they will prove very efficacious and along the lines demanded by the campaign of disease prevention.

MR. T. CHALKLEY HATTON:

The speaker was not present at the General Session this morning and unfortunately did not hear Professor Whipple's paper on "Sewage Treatment *v.* Sewage Purification," he assumes, however, from the remarks just made by Mr. Snow that this paper suggests first the proper purification of the water supply, followed only by such sewerage treatment as may be necessary to prevent nuisance.

If such suggestion has been made by Professor Whipple I cannot agree with him altogether, although appreciating that there are many situations when such procedure would be all that was necessary. Sewage treatment is not an act performed entirely for the benefit of those who actually perform it, but, in many instances, for the benefit of those who may be located within the same drainage area, and who are forced to use the waters into which the treated sewerage has been discharged, for domestic and other purposes.

It is not enough that those who actually use the water for domestic purposes should see to

it that it is made entirely safe, as there are times in the history of all water purification plants when the effluent therefrom is below the safety standard.

If a polluted water is being used at such a time, the chances are that the users of such effluent will suffer.

The speaker has an instance of this in his own mind. The City of Wilmington is located on the Brandywine River, about thirty miles below the Borough of Coatesville which has a population of about 11,000 persons, and which discharges its crude sewage into the Brandywine from which the City of Wilmington secures its water supply.

Wilmington installed, two years ago, a very efficient slow sand filter, and has operated it successfully with the exception of a very short period during February of 1912, when, through the formation of ice upon the filters, due to the long continual extraordinary cold weather, the filters became air locked, to some extent, and the character of the effluent was far below the standard, running from 25 b. per c.c. to 2500 per c.c.

At this time there was a very virulent epidemic of typhoid fever prevalent in Coatesville, which was unknown to the citizens of Wilmington, and before the knowledge of this epidemic came to Wilmington its citizens had become inoculated with it to some extent.

Had Coatesville been treating its crude sewage to such an extent as to eliminate the pathogenic germs, Wilmington would not have been endangered even though its filter plant had been temporarily working inefficiently.

In the speaker's judgment the citizens of a community have no legal or moral right to pollute the waters of a drainage area that another community living thereon cannot use them for any purpose desired with perfect safety, providing of course the latter community takes all reasonable precautions to protect itself from such pollution and in the light of our present knowledge of water purification such reasonable precautions are not such that a highly polluted water can at all times and under all conditions be made entirely safe, so that the drinking water should not only be purified but the sewage should also be purified of pathogenic germs.

MR. M. N. BAKER, *Montclair, N. J.:*

It is indeed unfortunate that the term "sewage purification" has come into such general use in this country. Only a few sewage treatment plants, the world over, attempt to *purify* sewage, the almost universal object being the prevention of nuisance.

In health-protective work, the constant aim should be to make each dollar save the greatest possible number of lives. A dollar spent for water purification and for various other objects will usually go farther in life saving than many dollars spent for sewage treatment.

DR. F. M. MEADER:

I come from a city of 140,000 people. About five miles distance is a village of 3,500 people. Between my city and this village is a small stream measuring about ten feet wide and two feet deep, and flowing at the rate of one foot per second. This stream passes through thirteen farms on which are kept 374 cows which supply milk to this city.

The sewage from the village is discharging practically untreated into this stream. The question arose, if this sewage contains numerous typhoid organisms, what danger might there be to our milk supply? In order to answer this question, we heavily polluted this stream with Bacillus prodigiosus, an organism which produces a red pigment and grows luxuriously at room temperature. At a distance of one and one-fourth miles below the place of pollution a cow's udder was polluted with the infectious material coming down the stream. Shortly afterward she was milked and the milk incubated at room temperature for 24 hours. At the end of this period it was found to have a red pigment, showing that if her udder was infected from a polluted stream the infection might gain access to her milk, and thus endanger the milk supply to which she contributed. The conditions, however, were felt to be such that the probability of such an infection occurring was more or less remote, but the possibility was present, and clearly marked out the line of safety; namely, to clean up the stream or keep the cows out of the brook.

THE CHEMICAL MEASURE OF STREAM POLLUTION AND SPECIFICATIONS FOR SEWAGE EFFLUENTS

EARLE B. PHELPS.

Read before the Sanitary Engineering Section, American Public Health Association, Washington, D. C. September, 1912.

Chemical analysis has long played an important part in the determination of the degree of pollution of natural waters, and in the measurement of the results of sewage purification. The methods employed for this purpose have been inherited from the older methods of water analysis almost without change. The latter were designed primarily to determine the purity of drinking waters but they have been adhered to in sewage work despite the fact that sanitarians have long since abandoned the idea of maintaining streams at a drinking water standard and in disregard of the present day aspects of sewage disposal. Sewage purification is essentially oxidation of organic matter. In the wellnigh perfect work of the slow sand filter the oxidation was so complete that it was conveniently measured in terms of nitrification. This is not a true quantitative measure of the whole work of the filter, but appears to be an end-point reaction indicating the completion of the process. With the introduction of rapid methods of purification designed for partial oxidation only, the test of nitrification and the whole scheme of chemical analysis fail utterly to meet the requirements of the situation. Hence the recent development and general use of putrescibility determinations. From a stream pollution aspect the older analytical procedure not only fails to define the quality of an effluent, but is actually misleading. Lederer[1] has shown that the removal by sedimentation of 63 per cent. of suspended solids results in an improvement in stability of only 31 per cent. In dealing with oxidation processes and employing as criteria of improvement the decrease of albuminoid ammonia and of oxygen consumed, the opposite effect is noted. A complete removal of the putrescibility of the sewage may be accompanied by an improvement in these analytical values of not over 50 per cent.

In stream pollution studies the condition is, if possible, a more serious one. Here there is no "per cent. removal" with which to cover the uncertainty of the result. We are given a definite statement that the stream in question contains so many parts per million of free and albuminoid ammonia or of organic nitrogen or oxygen consumed. We are expected from his information to draw a conclusion as to the present condition of the stream in question and the possible effect upon it of the discharge of additional sewage either untreated or partially purified. If these analytical determinations do not enable one to distinguish between organic matter in

[1] Am. Jour. Pub. Health, Vol. 2, 1912, p. 97.

its crude state and this same matter after passage through an oxidizing filter, he would be a wise chemist indeed who could give any proper interpretation to the results of such a stream analysis.

In approaching this problem, it is first necessary, as in the case of any measurement, to establish a scale or basis for such measurement. We are not dealing, in stream pollution, with albuminoid ammonia, or oxygen consumed as measured by boiling permanganate. We are dealing with nuisances of one kind or another. Let these be briefly enumerated.

There may be a bacterial nuisance, or danger, if water supplies or shell fish are involved. If so, our basis of measurement must also be bacterial, and not only that, but it must either be directly based upon the kind of bacteria which we desire to avoid, or if indirect, must bear some such definite relation to the undesirable germs that there can be no possible confusion. Even in such a simple matter as this, results of a misleading character are often reported. The total bacterial content of an unpolluted up-land stream, or of a sewage, stored after thorough disinfection, may vary enormously, but such variations have no sanitary significance.

If the removal of dangerous bacteria be one of the purposes of the purification treatment, then and only then is there a logical place for bacterial tests in the scheme of analysis adopted. The technique employed and the interpretation of the results must both bear recognition of an important fact; namely, while the removal of pathogens may safely be assumed to be no less complete then the corresponding reduction of total bacteria, the latter are subject to a subsequent rapid multiplication, not possible with the pathogens. This is especially important in the case of chemical disinfection. The time and place of sampling must be selected to obtain the maximum effect of the disinfectant and the minimum effect of the subsequent increase in normal bacteria.

Again the nuisance may be of purely physical character, due to the deposit of suspended or precipitated matter. Here also the basis of measurement must conform. Quantitative studies of suspended matter have, therefore, a direct bearing, but the ordinary "suspended solids," determined by filtration through paper, is of little interest. The English and German methods of determining "solids capable of settling" give results of more immediate value, for they show at least the present character of the sewage. Methods are still lacking for determining the rate of change in respect to suspended matter. Oxidation changes tend to precipitate soluble and colloidal substances, and sea water has a similar effect. Future research must attack this problem and must also recognize the time element in sedimentation. Strictly it is the "rate of sedimentation," not the total amount of sediment, that must be considered in computations of possible nuisance. Solids capable of settling may be lower in total amount in a trickling filter effluent than in the corresponding sewage but their rate of

settling is very much greater. In a stream they would deposit sooner, or would require a greater current velocity to prevent deposit.

The most common and most undesirable type of nuisance is that which may occur in polluted waters because of the exhaustion of the natural purifying powers. We deal here not with mere pollution, which is intentional, but with the determination of the capacity of the body of water to receive and dispose of sewage without the production of unsightly appearances or unpleasant odors. The latter are determined by certain bio-chemical reactions, which in their turn are most definitely related to the supply of available oxygen. These bio-chemical reactions can, therefore, be definitely measured and they constitute a true measure of the nuisance. Moreover, a proper knowledge of this relationship and proper tests of the sewage or of the effluent make it possible to determine in advance the final result of any anticipated pollution.

The actual scale to be used in making this measurement is, therefore, one of oxygen values. The zero point of the nuisance scale may be taken at the oxygen condition of normal unpolluted waters of the particular type in question. The 100 per cent. point of this scale may be defined for the present as the point at which an obvious nuisance exists in the stream. This latter point is indefinite in so far as there is at present no general concensus of opinion concerning it. The available evidence indicates that in slow-moving bodies of water a definite nuisance will result from the lowering of the dissolved oxygen below 50 per cent. of saturation in the summer time. A more definite statement of this matter is not necessary for the present discussion. In each individual case there must be a definite point at which nuisance begins and, wherever it be, this point represents the maximum permissible pollution and is the upper limit of the nuisance scale.

It would seem, therefore, to be a simple matter to define any intermediate stream conditions with reference to these two fixed points, but the matter is not quite so free from complications. The reactions involved are bio-chemical in their nature. The problem deals with progressive changes not with fixed conditions at any one moment. It requires for solution the establishment of a fixed point and of the direction and velocity of existing changes. The direction of the change may be toward either end of the scale according as the putrefying tendencies or the natural oxidizing agents of the stream are predominant. The former are now capable of exact determination as will be shown. The latter depend upon the physical characteristics of the body of water in question, and primarily upon the possibilities of re-aeration. In a quiescent body of water re-aeration is almost negligible and improvement by this means is at a minimum. In shallow, swiftly flowing streams the maximum effect is obtained. The determination of the magnitude of re-aeration in moving bodies of water constitutes one of the most important fields of future research in stream

pollution. Until this matter is placed upon a strictly scientific basis, the capacity of such streams to dispose of organic matter can be known only empirically. The absolute effect of the polluting matter upon quiescent water on the other hand is strictly determinable. The methods which Black and the writer have elsewhere proposed[1] are direct and simple in application. It is assumed in the first place that the well-known mass action law of physical chemistry holds for these reactions, an assumption which has been amply justified experimentally. Moreover, the reaction being a biochemical one is monomolecular. According to the mass action law, the velocity of such a reaction at constant temperature is a direct function of the concentration of the reacting substances, in this case the oxidizable organic matter and the oxygen. **The integrated form of the differential equation expressing this law becomes, log. $\frac{O}{o} = KtC$, in which O is the initial concentration of dissolved oxygen, o the final concentration, t, the time elapsing between the two tests, C, the concentration of the organic matter, and K the velocity constant of the reaction. For convenience the oxygen values are expressed in the unit, parts per million or mg per liter; time, in hours, and concentration of organic matter in per cent. of sewage by volume in the mixture or in the stream.**

This formulation is not accurate. It is assumed in integrating that C the concentration of organic matter remains constant during the test. This is only approximately true. Therefore, if tests are made at several different concentrations of sewage slightly differing values of the constant K are obtained. No general solution of the differential is possible and it is necessary in each case to employ a dilution approximately equivalent to that which will maintain in practice. In its simplest expression this formula means that over any given interval of time the putrescibility of the material, measured by its ultimate oxygen requirement, is decreased by a stated percentage of its total value at that time. This loss of putrescibility is accompanied by a corresponding loss of available oxygen in the stream, if there be no addition of oxygen from outside. Therefore, if a sample of the effluent in question or of a diluted sewage be stored in a sealed bottle at a definite temperature and for a definite time, the available oxygen, which can be analytically determined, is found to decrease. This decrease will be a logarithmic function of the time. If then the loss of oxygen and the time be noted in the experiment the equation may be solved for K. Having thus experimentally fixed the velocity constant of the formula for the sewage in question it is possible to determine the future course of the reaction at the given dilution and over any desired period of time. Still neglecting the re-aeration factor, the result of any anticipated stream

[1] Report of Col. William M. Black and Earle B. Phelps on the Discharge of Sewage into New York Harbor, New York City, Mar. 23, 1911. Contribution from the San. Res. Lab. of the Mass. Inst. Tech. Vol. VII.

pollution can be determined by simple tests of the sewage itself and by a knowledge of the dilution ratio in the stream. Hence the importance of further information on re-aeration in running waters, or of some empirical measures of the capacity of the stream to purify itself before the problem can be completely solved.

It will be noticed that in this discussion no attention has been paid to the actual quantity of organic matter present, which is usually determined. A small quantity of albuminoid ammonia or organic nitrogen in the form of highly putrescible material, such as fresh sewage, will exert the same influence as a large quantity in some stable form, such as is found in a partially purified effluent. It has even been found that artificial aeration of sewage may reduce its oxygen requirements materially without effecting any change whatever in the ordinary chemical analysis. It is not the quantity of organic matter, but its oxygen requirement which determines its effect upon the stream.

These principles may now be still further applied and in a more definite manner to the old problem of standards for sewage effluents, many bases for which have been proposed in the past. The most common of these is the "per cent. purification" referring to certain of the analytical features. A removal of 90 per cent. of the "albuminoid ammonia" or of the "oxygen consumed from permanganate" is given as a measure of the results of purification. If albuminoid ammonia or oxygen consumed had any definite relation to the nuisance scale which has been described, then their removal would be a definite measure of improvement. As they are found to have no such relation, their measurement can only be misleading.

In any case the total amount of polluting material discharged is the determining factor without reference to any previous degree of purification. One million gallons of crude sewage would work the same harm as two million gallons of half purified effluent, or ten million gallons, 90 per cent. purified. Hence, after a proper measure of polluting material has been established, the absolute character of the effluent and its volume, alone constitute the measure of its effects upon the stream. The expression "per cent. removal" is of interest only in experimental and preliminary studies.

Other standards for effluents have from time to time been proposed. They deal for the most part with absolute quantities but are in general faulty in two respects. Except for suspended matter they are based upon determinations that have no direct relation to the nuisance in the stream and they take no cognizance of the relative volume of stream and effluent.

The oxygen requirement of the liquid in question is the logical starting point for any quantitative statement of results. If this fact be admitted, the resulting solution is self-evident. Take, for example, a crude sewage. Let this be diluted in aerated water in a proportion, let us say, of five or ten

per cent. Then let the oxygen of the resulting mixture be determined in one sample at the start and in another sample at the expiration of twenty-four hours. The resulting loss is the oxygen requirement of this mass of the sewage during twenty-four hours at the temperature of storage. A definite proportion of the oxygen requirement of the sewage will have been satisfied. According to the mass action law already explained, the same proportion of the remaining oxygen requirement will in the presence of sufficient oxygen be satisfied during the next twenty-four hours and so on a diminishing ratio until equilibrium is reached. Knowing the form of this reaction curve, however, it suffices to consider it experimentally only during the first period. If the conditions are such that within twenty-four hours the stream in question will have entered the ocean or a much larger stream where ample dilution is provided, the oxygen requirement for 24 hours, as determined, need merely be balanced against the oxygen resources of the stream. It may be, however, that within six hours such ample dilution will be provided, or it may be several days. By use of the formula the net requirement, over any stated period of time, is readily determined. Moreover, it may appear that the dilution used experimentally is not that actually available in the stream. Again within reasonable limits the experimental results can be transformed to meet the practical requirements by the substitution of the proper dilution factor C. In the case of an effluent the procedure is exactly the same. If the effluent be sufficiently good no dilution will be necessary. The loss of dissolved oxygen of the stored effluent will be noted and the oxygen requirement of the organic matter over any period of time and in any other dilution will follow.

Under this procedure it is necessary to look first to the stream rather than to the effluent in the establishment of standard requirements. The stream without re-aeration has a definite quantity of available oxygen. It may be decided that this oxygen supply shall not be reduced to less than 50 per cent. of the saturation value during the warm months. If information is available on the rate of re-aeration, this additional oxygen may be added to the available supply in the computation. In the absence of any such information re-aeration may be left as a factor of safety. Starting with a definite oxygen availability in the stream and with known populations contributing pollution to the stream, the stream's power to purify sewage may be divided per rata among those populations, in actual quantity of oxygen expressed in any convenient unit, such as pounds per day. In each community then, the oxygen requirements of the sewage or effluent to be discharged must not exceed the available appropriation for that community. Allotments of this character must be made also for the future and not for the present. A young, rapidly growing community may have the same rights in the natural resources of the stream as its older and larger neighbor. If purification is to be demanded and if each community be

restricted to a definite allotment of the available purifying capacity, then the small growing community may at the start require no purification of its sewage, while its larger sister may reasonably be held to a much more severe standard. As it grows the younger community will gradually use up its appropriation and will be forced to partial purification. It should be the function of the central state authority to determine these allotments and to warn the various communities of the probable requirements of the situation in the near future. From time to time the actual oxygen requirements of the wastes of each community should be determined. This is done simply by testing properly collected samples of the sewage and calculating from the results of this test expressed directly in oxygen terms, and from the volume of sewage, the total oxygen requirement of the sewage in question. That community which may be situated nearest to the ocean has a geographical advantage which allows the use of a shorter time factor. In the case of New York Harbor and its tributary waters for example, a period of six hours suffices in many cases for the ample dilution of polluting material. The cities of Albany and Troy, however, discharging sewage ultimately into the same body of water would have their oxygen requirements determined through a period of weeks.

The matter of temperature has heretofore been touched upon but lightly. In bio-chemical reactions, however, this is a fundamental factor. The condition of a sewage measured by its oxygen requirement has been found to change as much as ten fold between early and late spring. In the warm weather also water carries less dissolved oxygen and the biological activities upon which all these results depend are enormously increased. Therefore, in all this work, summer conditions of temperature and stream flow must be considered. It is useless to make calculations under any other conditions. If summer conditions are adhered to the results will be satisfactory throughout the year. In determining the stability of a sewage or an effluent in the laboratory the work should be done at a temperature of approximately 20°. Higher temperatures have been suggested and in routine studies of sewage effluents these may be used with the understanding that they are indirect and must be frequently checked against the 20° result. All final expression of oxygen requirement must be referred to the 20° temperature, which most nearly approximates the summer temperature of streams. Not only is the velocity of the reaction increased at higher temperatures but the character of the active organisms is altered and there is no necessary constant relationship between the results at these two temperatures. Results can be obtained in a much shorter time at 37° and if these be frequently checked against the standard conditions their use is permissible.

In advocating this direct method of treating stream pollution problems, the writer makes no claim to originality, except in that he has brought together methods and ideas from various independent sources. The

mathematical treatment of the subject is one familiar to physical chemists. The analytical methods that are advised have long been used.

In 1870, Doctor Edward Frankland published detailed experimental results based upon the analytical determination of oxygen absorption in incubated samples. Frankland states[1] "Whether we examine the organic pollution of a river at different points of its flow, or the rate of disappearance of the organic matter of a sewage when the latter is mixed with fresh water and violently agitated in contact with air, or finally *the rate at which dissolved oxygen disappears in water polluted with 5 per cent. of sewage*, we are led in each case to the inevitable conclusion that the oxidation of the organic matter in sewage proceeds with extreme slowness: . . ." (The italics are mine.)

Frankland also refers to similar work by Sir Benjamin Brodie, published in 1886,[2] Spitta[3] in 1900 published two papers upon the self-purification of streams. He showed that in a polluted water, incubated, the oxygen absorption was dependent upon the availability of the organic matter as a bacterial food. He experimented with asparagin, ammonium-lactate, urea, dextrose, and cane sugar. Spitta makes no claim of originality for the analytical procedure which he uses and which is identical with that proposed here. He refers incidentally to similar work by Gerardin, 1875[4] and by Reichard, 1875. Letts[5] reported similar experimental work without making special comment on the analytical methods employed, which were evidently not new with him, and Adeney,[6] McGowan[7] and various other workers of the Royal Sewerage Commission of Great Britain have used the same methods. The use of oxygen absorption as a measure of the character of organic matter, is a matter of so long standing and of such general common knowledge that citation of original authority is as unnecessary as claim of originality would be futile. Nevertheless, Clark [8] points out that the method which is here proposed for dealing with this general problem and which was first published in the report on New York Harbor, previously referred to, cannot be original since he made oxygen absorption tests in 1900, and that so far as he is aware such tests were original with him. It is perhaps unnecessary to add that this well-known method of investigation is merely a useful tool in the work which is here proposed. The first serious suggestion to utilize oxygen absorption as a criterion of sewage strength and of the work of a filter, so far as the writer is aware, was made by McGowan[7] although Adeney[6] had paved the way for this suggestion by

[1] First Report, River Pollution Commission of 1868, p. 21.
[2] First Report, River Pollution Commission of 1865, Vol. II, p. 49.
[3] Arch. of Hyg. 38, 1900, p. 215.
[4] Compt. Rend. 1875, p. 989.
[5] 5th Report Royal Sewerage Commission, App. VI.
[6] Proc. Royal Dublin Soc. IX, 1900, p. 333.
[7] 5th Report Royal Sewerage Commission, App. IV.
[8] Mun. Journ. XXXI, 1911, p. 429.

a most elaborate experimental investigation. In this country Hoover[1] has made the first successful attempt to apply these suggestions in practice.

The writer had endeavored to broaden the scope of these general principles and extend their applicability to stream pollution problems in general. The view that we are dealing here with a definite set of chemical reactions, and the establishment of the fundamental chemical law by which those reactions proceed, seems to be essential to the full extension of the chemical work, and to a complete treatment of the results. The writer's earlier work on the methylene blue test [2] was based upon the same fundamental conceptions and the general adoption and satisfactory application of the relative stability number thus derived testifies to its soundness and value.

The formulation of the chemical law involved, in its differential form, is for all practical purposes an exact one. Owing to the varying possible relationship between oxidizability on the one hand and oxygen on the other, no general integration is possible. The assumption of a constant oxidizability during the progress of the test is reasonably approximate, and becomes more nearly true with increase of oxidizability, and shortening of the period of incubation. It becomes less accurate, therefore, in the case of well purified effluents, and is most available with sewages. Work is now in progress by which it is hoped to place this matter upon a more accurate basis.

The formula which is here proposed has been used in investigations of the pollution of New York Harbor with gratifying results. Determinations of the oxygen requirements of the sewage of one of the main outfalls of Brooklyn were made during an entire summer season. Upon the basis of these figures, of the contributing population and total flow in the area studied, and of an assumed contributing populations over all areas tributary to New York Bay, the actual withdrawal of oxygen from the various large subdivisions of the Bay was calculated. The resulting figures were further slightly corrected for re-aeration after a careful study of that problem. The results of these computations are shown below, side by side with the actual determinations made the following year by the Metropolitan Sewerage Commission. The Sewerage Commission's figures were obtained by careful study of certain cross-sections during various stages of the tide.

Dissolved Oxygen in New York Harbor Waters.

A. Calculated by Black & Phelps, February, 1911.

B. Analyses by Metropolitan Sewerage Commission for the year 1911, Reported August 1, 1912.

[1] Eng. News. 65, 1911, p. 311. 68, 1912, p. 451.

[2] U. S. Geological Survey, Water Supply Paper, 229, 1909.

	Per cent. A	Sat. B
Lower Bay:		
End of flood,	100	100
End of ebb,	71	74
Upper Bay:		
End of flood,	76	79
End of ebb,	54	55–56
Hudson to 96th Street:		
End of flood,	54	56
End of ebb,	48	54
East River Mouth to Hell Gate:		
End of flood,	53	55
End of ebb,	71	57
Hell Gate to Throg's Neck:		
End of flood,	71	57
End of ebb,	81	86

Our computations refer to the areas indicated in the table, while the Commission's figures are necessarily for cross-sections. In each case the value for the area in question at the end of the flood is compared with the average figures for flood and ebb at the cross-section down stream from the area in question; and at the end of the ebb with similar values for the cross-sections up stream from the area in question. In the single case of the Hudson River to 96th Street at the end of the ebb there were no up stream data available. The figure given is the average value for the ebb flow at the mouth of the Hudson. Obviously the character of water remaining in this section at the end of the ebb is worse than the average ebb flow, a fact which is indicated in the discrepancy of these two figures. With one single exception, the remaining figures show a striking agreement. There is evidently something wrong with our values at the region of Hell Gate, which has influenced the computed value of the ebb waters below Hell Gate and the flood waters above. It might be suggested that there is an influence of the Harlem River shown here which was not properly taken into account in our computation.

The agreement between the computed and the actual values, although gratifying, is of itself of little practical moment. Its value lies in the fact that it demonstrates the substantial accuracy of the methods which have been used in the analysis of this problem and makes it possible to use this same method in computing the probable effect of further increase in population, or of the discharge of additional quantities of sewage from regions not now tributary to New York Harbor. In this way the writer has computed the effect of the discharge of sewage from the proposed Passaic Valley sewer and the satisfactory results shown above give reasonable assurance that these computations, based upon the same general formula and hypotheses, are substantially accurate.

SUMMARY.

Bacterial tests may be used to measure the results of disinfection treatment, whether it be by biological or chemical means. Determinations of "solids capable of settling," including matter that may be precipitated, and especially the "rate of sedimentation," are needed when sedimentation is a factor in stream pollution.

The quantity of organic matter present in a sewage or effluent or in a polluted stream is in no sense a measure of the effect of that organic matter upon the stream. That effect can best be measured and expressed in terms of oxygen requirements. Since the oxygen reactions are progressive, the statement of oxygen requirement must be made for a definite period of time. This requirement may be determined experimentally in the laboratory by noting the rate of decrease of dissolved oxygen in an incubated sample, diluted if necessary, and by making the proper substitutions in the mass action formula which has been found to apply to this case. The ultimate oxygen requirement of the sewage of a community expressed in pounds per day may then be balanced against the available oxygen resources of the stream into which this sewage is to be discharged, and the resulting figure will show the effect of such discharge upon the dissolved oxygen of the stream. If the effect is to reduce the dissolved oxygen of the stream below the permissible point, further purification is indicated. If two or more communities are contributing to the same body of water the total oxygen of the water may be apportioned in an equitable manner between them. In all these computations, summer conditions of temperature and stream flow must be assumed and in each individual case the time factor of the formula must be made to correspond with the time required for the body of sewage in question to become sufficiently diluted in an increasing volume of water to carry it safely beyond the danger point. The examination of crude sewage is of value in experimental studies of purification methods but the absolute quality of the effluent alone effects the stream, regardless of the relative improvement.

Chemical analysis of a sewage or effluent conveys no information that is at all commensurate with the labor and cost involved. The interests of economy and scientific accuracy demand that the routine analysis be replaced by tests, having direct bearing upon the particular case, and interpreted in the light of full knowledge of the volume and physical and chemical characteristics of the body of water into which the effluent flows.

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THE SKILLED SUPERVISION OF SEWAGE PURIFICATION WORKS.

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Read before the Sanitary Engineering Section, American Public Health Association, Washington, D.C. September, 1912.

Introductory Statements.

This paper is not intended to be more than a rough outline of facts which obtain relative to the necessity for skilled supervision over the operation of sewage disposal works.

The term "sewage," in the sense used, applies to all domestic and manufactural wastes conveyed away from the premises by water carriage.

The terms "sewage purification plant" or "sewage disposal works," as herein used, apply only to works designed and built for the treatment of a considerable quantity of sewage. Night soil disposal and percolating cesspool methods are not included, neither is a sub-soil irrigation lay-out, unless it be of sufficient size to demand the services of an engineer to design and construct it. Sewage works may also include the sewers of a system.

For purposes of discussion, sewage disposal works may be divided into four classes; first, the town plant to serve the city, borough, township, village or hamlet; second, the hospital or institutional plant; third, the plant for a private estate; and, fourth, the plant for the industrial establishment in which trade wastes are handled.

Also for convenience it is premised that the sewage works have been properly designed and carefully built and are capable of performing the work put upon them, provided the plant be properly operated. The majority of plants are not properly operated, nor properly designed and built.

With respect to all four classes of plants, it will be agreed that lack of attention to the proper operation thereof will result in failure, sooner or later. In consequence there may follow a nuisance or a menace to health, or both; but always a failure means a waste of money. It will also be agreed that attention to the operation of sewage works if applied with lack of comprehension of the principles involved is more than likely to result in failure and waste of money. These conclusions apply with particular force to the town and trade waste disposal works; to town sewage works because of the large volume treated, the extensive scale upon which the works are laid out and the far-reaching results likely to accompany mismanagement and failure; and to trade waste disposal works because it would be the height of folly to employ expert chemical engineering and

provide a plant for the treatment of the peculiar wastes in any instance, whether the object be a sanitary accomplishment or a profitable reclamation of ingredients, or both, and then to neglect to give it the necessary expert attention thereafter.

The citizens of many of the states of the Union have determined it to be good public policy by statutory regulation to provide for the abatement of nuisances and the protection of water supplies and in the furtherances of this policy to establish central control of water and sewage works. What can be the sense in enforcing these laws where the constructing of sewage purification plants is involved if such plants when built are not to be efficiently operated and maintained?

Negligent Operation of Small Plants Particularly Notable.

Now with respect to the hospital or institutional plant and the plant for a private estate, while it is true of both that neglect in operation speedily results in a nuisance, it is particularly true of a private estate. Engineers of high reputation avoid and not infrequently refuse absolutely to have anything to do with the designing or building of a sewage disposal plant of this class. Where there is positive assurance worthy of acceptance that the plant will be faithfully operated, the engineer may furnish the plans, superintend the construction, and, leaving written instructions covering operation, depart feeling reasonably certain that the results will prove satisfactory to the owner and to himself. This exception is a rare one. Usually the plant is neglected, failure comes, the engineer is blamed and the profession suffers. No wonder then that an engineer careful of his reputation is cautious about having anything to do with disposal works for private estates and that this class of service has been taken up largely by contracting firms and corporations. Companies of this kind have circulated descriptive pamphlets of sewage disposal works adapted for private estates or hospital installation. Thousand upon thousands of such works have been built under guaranty of successful operation; but this guaranty may be fixed to expire well within the period subsequent to which a failure is inevitable. In consequence not a fatal but a serious blow has been delivered against the popular acceptance of modern methods of sewage purification. Prominent citizens because of unhappy experiences with the disposal of sewage on their own estates, have exerted their influence with voters against the proposition to increase the municipal bonded indebtedness to defray the cost of building a system of sewerage and sewage disposal for the town.

What Proper Attention for Each Class of Plant May Embrace.

It is feasible for proper attention to be given to the operation of all four classes of plants; it is also feasible to provide constant skilled attention

for the town and industrial plant, but it is not necessary for the hospital or institutional plant, or for the plant on the private estate.

For the private estate, an occasional inspection by an expert and his written instructions to the owner or operator should be sufficient.

For the hospital or institutional plant, occasional inspection by the expert, supplemented by such supervision as he may give in writing after looking over the reports of daily operations of the plant furnished to him weekly or monthly by the attendant in charge should be sufficient. Under such supervision, an attendant of ordinary intelligence should be competent to secure satisfactory results. By this system of skilled supervision over the work of the daily attendant in charge, all the care necessary may be provided. The frequency of the expert's visits and of his perusal of the reports of daily operations, and the nature of his written instructions must depend upon the size of the plant, its type and location.

For trade wastes disposal it is quite probable that the situation may demand an expert in charge.

For the town plant (which class covers a range from the real-estate development scheme—in its beginnings perhaps properly belonging to the institutional class—to the sewage works for the largest city), where the works are for a large municipality, constant expert attendance, a laboratory and the making of daily tests and records are required. It is a question where the line should be drawn between works demanding constant skilled attention and those demanding no constant skilled attention. This question must be arbitrarily determined. The type of plant, the work to be accomplished—whether the object be the prevention of a nuisance or the protection of a public water supply—the size of the work and amount of money involved, all are factors of greater or less value, varying at different sewage works, which must be considered in reaching a rational conclusion as to whether skilled supervision shall be constantly employed on the premises.

For a small town plant, situated on a small stream above a water works reservoir or intake, where the high degree of purity demanded and, where the local topography and geological formation precludes the use of any but works of the type that easily fluctuate in efficiency 40 per cent. on temporary neglect or oversight in operation, it is obvious that responsible skilled supervision must be employed.

The same is true with respect to the plant for the village or hamlet; but in these latter places the amount of money involved is small and the financial ability of the users of the sewers would be proportionately overtaxed were a skilled attendant to be constantly employed on the premises. Hence, satisfactory results must be secured in some other way. It is not alone a question of efficiency in results but also a question of finance.

In small communities the question as to the feasibility of sewers at all

is involved. Possibly, cesspools and privy vaults and control of night-soil disposal are methods more practicable.

On the other hand, there might be a large town amply able to employ constant expert service where the object of the sewage works—the prevention of a nuisance—involves largely the question of sludge disposal. In a type of plant adapted to the accomplishment of this object, the kind of expert supervision over the man in daily charge required for the individual estate may be sufficient.

Why Skilled Supervision Should be Compulsory.

The question whether constant skilled supervision shall be employed must be determined by the local authorities primarily, or if such constant supervision be necessary, though lacking, then the state authorities must have power to compel its employment, by the municipality, the corporation or the individual. If the state exercises its power to compel this service then it follows that it might well exercise power to regulate the minimum compensation of the skilled employee, to assure the class of service demanded.

In most states there is no such thing as legal engineering or state supervision of engineering or of the relation of the engineer to the Commonwealth, a fact discreditable to the profession in the minds of many of its members and in public estimation.

Take for example the case of water works management. Until recently the courts seemed to support water companies in the contention that a reasonably pure and wholesome water meant the best water obtainable in its natural condition. But the art of treating and purifying water to render it reasonably safe for domestic uses has advanced to such a stage that municipal and private corporations engaged in water works business are compelled now to take cognizance of these facilities. However, a water filtration plant is subject to breakdown. Furthermore, even if it be properly designed and built, yet by careless operation and negligent maintenance a partially purified water may be admitted to the water works system and in this manner and because of this possibility there is a risk and menace to public health where the source of supply is polluted with sewage. As a rule mechanical water filter plants are not operated by men trained for the purpose. Is it sufficient that the town authorities or the company that furnishes a polluted water to the public shall be convicted of committing a crime punishable by a severe penalty where such occurrence could have been avoided by reasonable precautions? No! most emphatically *no!* The people want protection—not penalties—and it is for the people to determine whether by law it shall be compulsory to place in responsible charge of water works and sewerage systems and sewage disposal plants men specially trained for the purpose. Our

technical schools and universities are turning out graduates qualified to assume these duties. It is within the power of the legislature to place under the control of the proper state department the regulation of the class of attendants put in charge of these works.

Building contractors, plumbers, manufacturing corporations, railroad and transportation companies, doctors and lawyers are under state regulation. The engineer alone remains without the pale of state control. There is no argument whatsoever in support of this situation if the regulation of affairs of other professions and trades be good public policy. There is a growing sentiment in several states in favor of the enactment of law, and it should be as uniform as practicable, making it compulsory for public authorities having charge of water works, sewerage systems and disposal works and other public works, to employ on those works only such engineers and attendants as have been certified by the state as competent. Why so many comparatively trivial matters should be regulated by state law and yet so important a thing as the constructing and operating of water works and sewerage systems and disposal works, dealing as they do so intimately with the health of every individual of the town, has meantime escaped the attention it demands, is accounted for perhaps very largely by the fact that engineering is a new profession and that it has had hardly time to ponder the problems of its own existence as the older professions have done.

State Control Indispensable Though Supplementary in Character.

It is settled then that there must be more attention given to the operation of sewage works if efficiency and economy are to be achieved, that either constant skilled supervision or occasional skilled supervision is required, and that state control to some extent is indispensable. Hence the question arises how far should the state go in exercising supervisory power over the operation of sewage works.

In a number of states sewage purification works are rarely built except under compulsion. In Pennsylvania the commissioner of health decrees, under agreement of the governor and attorney-general, when sewage works shall be built and the municipality, corporation or individual, recipient of the decree may appeal to the courts from the decision and decree of the state authorities, and the order of the court is final. The point I wish to make is, however, that the initiative rests with the state health authorities, men fitted by training and experience determine what is prejudicial to the public health and wherein the interests of the public health must be conserved, since no other than men of this type are competent to perform this professional service. To offset the possibility of arbitrary judgment becoming tyrannical, appeal to the courts is provided, but whether or not the court be the final agency through which the power

is exerted is immaterial; back of it all is the police power of the sovereign state which can compel the building of sewage purification plants and can be extended to regulate the supervision of their operation, in order that they shall accomplish the object for which they were built.

If the owner of the plant chooses to employ constant skilled attendance, where occasional skilled supervision would be sufficient, that is his own concern only, but where the said owner refuses to employ any proper attendance whatsoever he must be compelled to do the necessary thing and the state, in exercising this extension of its police power intelligently, must base its decisions on facts and information collected through systematic oversight of the operation of sewage works, this oversight being supplementary to, but not a substitute for, that which the owner of the plant should employ.

The sewage disposal expert is not hindered in his service under this method of state control, but his professional interests are aided and abetted thereby. Up to this point there should be no debate as to policy; but beyond this point each state must work out for itself how far it shall go in this work of supervising the operation of sewage purification plants and in establishing standards of operation and reports.

Statistics of Operation the Foundation of Efficiency and Economy.

It is indispensable to the general welfare to know just how and where money-waste with respect to sewage works is occurring and whether it is on the increase or decrease. Such knowledge can come only from statistics. It is the duty of citizens everywhere to stand for efficient registration of data relative to sewage disposal operations. Sanitary engineers, above all others, should make themselves conversant with statistics and the science of their interpretation.

The opportunity to reduce waste of money in installation and operation methods respecting sewers and treatment of sewage is extensive enough to amount to a pressing demand.

It is pertinent to remark that in no department of public hygiene has more rapid progress been made in the United States than in the introduction of pure public water supplies in cities. Undoubtedly the old-time well, spring and cistern waters of the town, abounding as they did in sewage pollutions ofttimes, caused more sickness and death than any other one medium of transmission of infection. Statistics relative to morbidity and mortality from all causes, gathered by local, state and national bureaus are accepted as necessary. Why not the same attitude towards statistics of operation of the public works built to prevent disease and mortality? In at least one state the owner of sewage works is required to keep a register of daily operations at the plant and to transmit copies thereof every month to the state health department. These data are

the very foundation for accurate knowledge. Where such registration is brought to the highest proficiency, the greatest progress in efficiency and economy will occur.

There should be uniform registration of data relative to sewage-works management and operation. To accomplish this result there must be compulsory obedience to the reasonable requirements of law or infliction of a penalty in cases of violation of the law.

One of the important subjects which should be included in a standard curriculum prepared for technical colleges, is statistics relative to water works and sewage works. Their value, the methods of their utilization and the manner in which they touch at so many angles in our complex system of social organization make it imperative that the student of sanitary engineering and of economics should be thoroughly familiar with the subject. The collection of these data is a public duty and this implies and emphasizes the necessity for skilled supervision of sewage purification works.

Chemical and Bacteriological Data Necessary.

So we see that where skilled supervision is, there is collection of data also. Should there be chemical and bacteriological analyses as a part of the statistical data of operation? Yes, from a general standpoint; but both should be dictated as to nature, extent and frequency, by local conditions, of which there is a wide range.

By whom should these laboratory tests be made? Naturally the state should make some tests directly and others indirectly by regulating what a local laboratory report should cover. The town laboratories erected at or maintained in connection with the sewage works and other municipal departments would naturally be employed also. The private laboratory may be called into requisition, as at an institution or occasionally for the individual plant owner, or the small town.

The type of plant and local circumstances must determine the kind of test to be made.

(a) For instance, where the problem is one of sludge disposal and the dilution of the liquid to obviate a nuisance, physical tests should be made daily, weekly, or monthly, to determine the amount of suspended solids in the raw and settled or treated sewage, measurements of the volume of sewage treated and of the river or body of water into which the effluent goes should be made and also simple chemical and bacteriological tests to roughly indicate the work performed by the artificial process as a practical aid to Nature's process of purification in the river.

(b) Where the object of the plant is to protect a public water supply, more data are required. Chemically, it is desirable to know, with respect to the solids treated, the amount suspended in the raw sewage and the

amount removed therefrom—first, in the tanks; second, in the filters; third, in the resettling tanks; and the amount remaining in the effluent, if any; also the condition of the solids, whether organic or mineral, putrescible or inert.

With respect to the liquids treated, it is desirable to have bacteriological analyses of the raw sewage, of the filtrate and of the effluent from the plant. Presumptive tests are not sufficient; actual counts must be had for comparative purposes. Often local conditions must determine whether to examine the raw sewage or filtrate, but it is always important to examine the final effluent. It is usually helpful to know the efficiency of the filters, tanks and sterilizing process, as units. There should be colon determination for the final effluent, also putrescibility tests whenever a chemical germicide is used.

Not infrequently at institutions and hospitals is to be found a laboratory easily adapted by the resident chemist or pathologist for sewage analyses. This scientist can make the simple tests at the plant daily and the more complex ones less frequently; but for the private estate simple chemical and bacteriological tests every month may be sufficient. Local conditions must control.

For the town, the simple tests should be made daily and the more difficult ones daily, weekly, or as advisable, depending upon the size of the works and other controlling circumstances.

For trade wastes disposal, the whole object sought may be the profitable reclamation of ingredients, or it may be largely a matter of avoidance of a nuisance, or it may be directly or indirectly the protection of the public health; directly, as where anthrax infection of a public water supply comes from a tannery; indirectly, as where paraffin, or creosote, or acid, or coloring material, in raw water operates to render water filters inefficient to the prejudice of the public health, thus interfering with a necessary and important and all-essential use of waters that in their natural state are potable.

Conclusions.

The art of water purification is not keeping pace with the increasing pollutions of the sources of water supply in some districts of certain sections of the country.

There are few real experts in America, or in any other country, competent to approximate an opinion of great value relative to the comparative wholesomeness of different natural waters used as sources of public supply. Do not misunderstand me. There are hundreds of trained minds experienced in water works and water purification competent to give a conclusive opinion as to the relative quality of waters with respect to color, turbidity, softness and bacteriological and mineral

constituents, who are perfectly competent to devise works and erect them for the conservation of supplies and for treating turbid or polluted water to render it clear and sparkling and reasonably free from microörganic life; but there their knowledge as experts ceases.

The doctor who observes the state of health of his patient may be a skilled enough diagnostician to reasonably satisfy himself that the water obtained from the public supply is injurious to this particular individual although the majority of the citizens of the town getting the same public supply are apparently not injuriously affected. It is a well-known observation that some individuals, to keep healthy, must have water to drink that is free from much mineral matter, and that other constitutions can stand waters heavily charged with minerals. In a city the number of human beings susceptible to the injurious influences of a hard water may be large and yet escape attention. Generally speaking, foreign matters in natural waters are not useful or helpful to the animal economy. Attempts to neutralize them by the addition of more chemical are countenanced in modern methods of water treatment. The water chemists of the country are a unit in support of the statement that the use of chemical coagulents and germicides in the treatment of public water is not injurious to public health. Probably we can all agree that the natural mineral constituents of a public water supply need not necessarily condemn the source, where there is no choice as to source or potability of the water.

We all would prefer a clear, soft natural water, comparatively free from mineral constituents and organic life. It is impossible to obtain such water in many places, and artificial methods have to be resorted to. The proposition which I submit is that it is better to keep foreign ingredients out of the natural waters, if this can be accomplished by a feasible plan, more particularly with respect to ingredients discharging into sources of supply from industrial operations and sewers. The baneful effects of trade waste pollutions may be readily manifest to the senses of sight, smell and taste. The baneful effects of sewage pollution are sometimes strikingly manifest in a startling outbreak of typhoid or other epidemic of water-borne origin. The bacteriologist will state how many sewage organisms may be found in a given volume of the raw water. He may find the sewage organism in a cubic centimeter, or he may find it present in three, five or ten cubic centimeters. He will not guarantee that the typhoid germ is not lurking in the supply, even though he may not be able to detect it in his sample.

Within the last few years, with increased knowledge attained by observation of the working of water filters of different kinds, has come lack of that absolute confidence previously extant in the ability of the filter to remove harmful organisms. Today, hardly a filter plant in the country is being operated, regardless of type of plant, without the use of chemicals

and germicides. If the germicide be not used constantly, it is held in readiness for emergency use, a recognized additional safeguard that the conditions demand shall be afforded to the public health.

It should be sufficient, without exposing the weak points in modern methods of water treatment or the limitations in modern bacteriological technique, for me to commend to your thoughtful consideration the proposition that the public health in districts where the people are supplied with water drawn from streams receiving sewage demands a double safeguard. The first barrier to the spread of the infection reaching the stream as sewage should be in the treatment or control of the sewage at the point of discharge. "Kill the germ in the bed-pan" is the ideal that would wonderfully reduce typhoid-fever, if it were feasible of accomplishment. The next best place to kill the germ is at the mouth of the sewer. The second barrier to the spread of the infection through water-carriage is at the water works intake below, where a treatment plant adapted to the conditions is necessary. It is not sufficient to rely on this water purification plant. It has been demonstrated in Pennsylvania time and again that public policy demands the control of the discharge of sewage into the stream above the water works intake.

Summarizing the foregoing remarks, I have shown the necessity for supervision of sewage purification works of all kinds, and these different kinds have been classified into four divisions. After discussing the possible results of negligent operation of the several kinds of plants, I have outlined what proper attention for each class of plant may embrace. This was followed by reasons why skilled supervision of the operation of sewage works should be compulsory, and I then showed that state control is indispensable, although supplementary in character. The foundation for high efficiency and economy in the operation of sewage purification works must be statistics and I have suggested the scope of these statistics, making special mention of chemical and bacteriological data. The scope of the subject is broad and the enforcement of compulsory skilled supervision of sewage purification works involves the exercise of not only local but also state and national police power. Therefore, it would seem fitting that a committee should be appointed to consider at length the entire subject and to report on standard methods of operation and supervision of sewage purification plants.

DISCUSSION.

MR. H. P. EDDY, *Boston:*

Mr. Snow has very ably pointed out the necessity of placing the management of sewage disposal works in the hands of skilled employees, wherever this is practically possible, and in other cases the advisability of providing at intervals such skilled general supervision as will insure the successful and wise operation of such plants.

There is one vital difference between the conditions affecting the operation of a water purifi-

cation plant and the management of sewage disposal works. In the former case, the interest of the operator, or manager, lies in the successful operation of the plant, for any failures of the plant immediately affects the people to whom the management is responsible. If poor water reaches the mains, the consumers—who are the citizens of the community, are immediately cognizant of the fact and the water works superintendent, be he a municipal employee, or the agent of a company, is promptly advised of the unsatisfactory condition of the water supply. It is, therefore, wholly to his interest to provide the very best management for the water works.

On the other hand, the interest in the sewage disposal works is entirely different. Such works are generally located at a distance from the center of the municipality, if they are not carried beyond its boundary lines. The only interest of the citizens who pay for the maintenance of these works is that their wastes be removed with as little inconvenience to them as possible and at the lowest cost. If the sewage purification works break down for any reason, the evil resulting is not usually visited upon the people resident within the municipality, but upon their neighbors down stream, within a different municipality, and possibly beyond state boundaries. The primary interest of the community in the operation of its disposal works, and of the manager in charge of such plants, is to accomplish the necessary result at the least cost. The character of the work done is usually one of secondary importance to the parties owning the plant.

Bearing in mind this distinction between the interests of the community in its water works and its sewerage works, it is easy to see why the management of sewage disposal works is generally far below in efficiency that of water works, and it is axiomatic that this difference will always be more or less apparent. It is primarily because of this difference in interest that the management of sewage disposal works may need some strict police supervision either on the part of state or national boards of health, or indirectly through litigation. Thus far, it appears that litigation has been a very important factor in securing the construction and operation of sewerage treatment works, and it may be that it has been the most effective agent in bringing about the results thus far obtained. This is the only line of action which the injured individual, or community, has readily available, by means of which it can require its neighbor to cease causing objectionable conditions. The other means, which is not usually so readily available, is to invoke the action of the state, or national legislative bodies, to pass such laws and create such boards as may secure from one community the proper disposal of its sewage, so that it may not prove an offense or a danger to another. This latter course is often slow and may require many years to become effective. Fortunately, at the present time, several of the states have endowed their boards of health with sufficient powers to study and report upon objectionable conditions caused by the discharge of sewage, and in a few cases, to require their correction. These powers have not usually been sufficiently comprehensive to include police supervision of the operation of such works, and it is very doubtful if it is desirable that such boards be vested with such arbitary authority. In the opinion of the writer, it is desirable that such boards be given sufficient authority and funds to enable them to examine sewage disposal plants from time to time, and to make occasional analyses by which it may be possible to show definitely what is accomplished. In this way, available data will be accumulated, which can be interpreted by sewerage works managers in some cases, or in others by engineers appointed to assist in the operation of such plants. This method has been adopted by the State Board of Health of Massachusetts and very valuable data have been accumulated during the past twenty or more years. These operation records are referred to very frequently by engineers making studies of sewage disposal problems, both in connection with their studies of the type of plant to be built, and also where they are interested in the efficiency of existing plants. The expense of this work is not great, and it does not throw an undue burden upon the state, or upon the health board.

More attention should be given by the municipalities to the appointment, or selection, of

sewage works managers. As in every other official position, even trained in this class of work should be selected to conduct it. The expense of securing such managers will, of course, be too great for many of the small towns to bear. This condition can be met by employing specialists who will take a general oversight of the operation, make occasional visits to the plant, and interpret analyses made by official boards, or their own analyses where the others are not available, or are not made with sufficient frequency. The expense of this latter method, including occasional visits for personal inspection, should not be prohibitive for very small communities, for institutions, or even for owners of large private residences.

MR. PAUL HANSEN, *Engineer Illinois State Water Survey:*

The points brought out in Mr. Snow's paper regarding the necessity for more competent supervision over sewage purification plants cannot be too greatly emphasized. In my experience in the Middle West I cannot recall any small sewage purification plant, that is to say, plants for towns of ten thousand or under, that is being effectively operated. Out of some thirty-five sewage purification plants investigated by the State Board of Health of Ohio during 1907 and 1908 not one when first visited was receiving adequate supervision. Nor was it possible for the State Board of Health through its representatives to persuade the local authorities to adopt the right kind of supervision in any material proportion of the cases. Thorough examinations of the plants and complete instructions left for maintaining the plants in proper condition resulted in a very material improvement, but the improved conditions in most instances lasted only for a short length of time. In some cases, this was due to careless neglect; in other cases, due to changes in officials and employees.

Recently in the State of Illinois I have had occasion to visit six purification plants not one of which was giving satisfactory results. Only one had an operator in charge. This particular operator was somewhat old and decrepit and seemed to pride himself on how little he knew regarding the plant. The responsible authority in this instance seemed to be the superintendent of streets who rarely saw the plant, and the caretaker operated under his orders, doing just as much and no more than he was told to do. While conscientious in his way, his lack of knowledge of the mode of operation of the plant resulted in the by-passing of crude sewage into the stream during a large portion of the time. At another plant a certain amount of attention was given by the street department, but this attention was given solely for the purpose of giving the plant a presentable appearance. The weeds were cut, and the limestone in the contact filter was carefully protected against contamination with sewage, so that they remained pure white and unsoiled. Meanwhile, the sewage was merely passing through a septic tank and then being discharged into a very small stream where it created a very foul nuisance. The other plants were for the most part without any supervision whatever, had fallen into disrepair and were producing poor effluents.

Thus far, no practical way has been brought to my attention for securing proper operation of sewage purification plants except by giving some central state bureau or commission authority over the operation of sewage purification plants (and water purification plants), with ample funds for making their authority effective.

Special emphasis should be given to Mr. Snow's suggestion that many of the smaller plants both for purifying water and sewage may be adequately taken care of by occasional expert supervision such as can be given by consulting engineers. I should like to urge all sanitary engineers in state positions to foster this practice as much as possible not only in connection with water and sewage purification works, but also in connection with water supply and sewerage systems as a whole. Should there be developed a common practice among smaller communities for retaining the services of the consulting engineer, which, by the way, may be done at almost nominal expense considering the benefits derived, we might hope to see these municipal enterprises which in many instances are flat failures and in many other instances extremely uneconomical in operation, placed upon a sound and efficient basis.

THE SLUDGE PROBLEM.

LANGDON PEARSE,
Chicago, Ill.

Read before the Sanitary Engineering Section, American Public Health Association, Washington, D.C. September, 1912.

To maintain clean waterways, free from general or local nuisance, attention must be paid to accumulations of sludge, since the heavy material coming from sewers and industrial plants will usually be deposited, as soon as conditions permit, in banks of varying extent, which may decompose and give off disagreeable odors, even though considerable dissolved oxygen be present.

The topic here considered is the relation of sludge deposits to nuisance and the cure thereof. The effect of continued discharge of settling suspended matter into waterways will depend on the dilution, the velocity of flow in the water course, the dispersion, and the character of the suspended material. From the standpoint of nuisance, the physical conditions of the place of discharge may be classified (1) where the deposits are always under water and (2) where the deposits are exposed during part of the day, by tides or the lowering of water in a mill-dam. From the hydraulic standpoint the division may be made of (1) velocities sufficient to prevent deposit, (2) depositing velocities, and (3) quiescent conditions. The displacement of a tidal prism is comprised under the preceding heads.

In general, several alternatives are possible for relief, either (1) dredging out the deposits at intervals, or (2) diverting the sewage by a bypass or intercepting sewer and outfall to some point where the discharge may not be objectionable, or (3) preventing the formation of the deposits by the actual removal of the suspended matter by screening, sedimentation, or more thorough purification. To settle the course to pursue, not only the cost but the possibilities of nuisance and the desirability of good appearance must be considered. In other words, effectiveness and cost should be balanced to suit the physical conditions of the locality.

On the subject of sludge accumulations and their effect on the overlying liquid but little quantitative data exists. Most of the recorded observations are qualitative in the sense that many observers report that a great nuisance has existed where sludge banks were permanent and that dredging out the material improved conditions. Considerable attention has been given in many cases to the study of the extent of deposits, as, for instance, the description of the sludge nuisance in the Back Bay Fens in Boston, detailed by Mr. John R. Freeman in his report to the Charles River Dam Commission in 1903. The nuisance there was so marked and the depos-

its of sludge so large for a small stream (in amount one fourth the entire capacity of the basin) that extensive dredging was recommended and the removal of the sewage by means of sewer extensions. In the case of the Providence River in the city of Providence, R. I., a varying degree of odor has been commented on by the State Board of Health and by the city engineer, Mr. Clapp. Dredging has relieved conditions very markedly although some of the same material still enters the stream. No exact measurements or details, however, have been given.

In the report of the Sanitary District of Chicago, October, 1911, the chief engineer, Mr. George M. Wisner, has described conditions of the fill in the main channel of the Sanitary District and given analyses of the same. The analytical data shows a rather heavy material compared to the sludge found in sewage disposal plants, resembling more nearly a grit chamber sludge than a true sewage sludge. The effect of the sludge on the water passing above in the canal is detrimental although quantitatively difficult to express. From the most marked sludge deposits just above the power house, considerable ebullition of gas occurs in the summer, and even in the winter, which helps in maintaining the oxygen content at a very low level. In portions of the canal near the city studies have been made on the distribution of oxygen in the cross-sections and a difference has been noted between the content at the top and the bottom, the bottom usually being lower. Some variation has also been found between the two banks before mixing is complete, a distance of four to five miles. Where the oxygen content is low the distribution through the section is practically uniform, complete mixing having taken place.

The presence of large sludge deposits and scum in the arms of the Chicago River, known as the Stock Yards slip or Bubbly Creek, is responsible for a condition of nuisance and degree of odor which might not occur to such degree could the suspended matter be kept moving and even partially oxygenated. Dredging has been carried on at times.

In New York Harbor, reference has been made to sludge deposits in the report of the Metropolitan Sewerage Commission and comment has been made on the indications of oxygen in the lower layers of the water through the presence of a reddish surface on the black sludge. This phenomenon indicates the oxidation of the ferrous sulphide. This has also been observed in experiments in the laboratory of the Sanitary District of Chicago where several inches of sludge were placed in the bottom of shallow jars, the liquid above containing oxygen.

A few quantitative experiments, made by Mr. Harry W. Clark, are given in the report of the Charles River Dam Commission, 1903, in which 2 gms. of mud or sludge were placed in half-gallon bottles full of fresh water, or salt, and the reduction of oxygen was followed. In five days the oxygen in fresh water was reduced to an average of 61 per cent. saturation from

an initial complete saturation, the extremes being a reduction to 81 per cent. and 33 per cent. saturation. An experiment was also made, with continuous flow, using 9 inches of mud in a tank 12 feet deep, the liquid being at first 5 and later 7 per cent. sewage. In general, the surface layers contained more oxygen. Comment is also made on the production of odors in tidal waters by bacterial reduction of the sulphur compounds in sea water. In the examination of the conditions in the Fens basin, referred to previously, it was found that hydrogen sulphide was formed which rose through six feet of water. No oxygen was found below a surface layer 6 inches deep.

On the absorption of oxygen by sludge some interesting comments have been given me by Mr. Almon L. Fales, supervising chemist of the Sewer Department in the City of Worcester. In 1903, he conducted some experiments on the aëration of sludge and liquid in a tank holding 1,500 gallons and found that in the early period of the experiments it was necessary to aërate several times a day but later once in twelve hours proved sufficient. It was also observed that the dissolved oxygen disappeared much more rapidly in the layer just above the sludge. Occasionally after twelve hours or less had elapsed after aëration the dissolved oxygen would be exhausted in the layer just above the sludge while the top liquid would still contain as high as 25 per cent. saturation. After the experiments had been continued for three weeks it was found that the liquid just above the sludge lost all dissolved oxygen in twenty-four hours while the top liquid showed 125 per cent. saturation. The super-saturation was caused by the propagation of chlorophyl-containing micro-organisms which gave the liquid a greenish tint. Similar phenomenon can be noticed at times in streams of intermittent flow where the dilution is not sufficient to prevent nuisance.

In shallow windswept waters, sludge deposits may prove a greater source of odor, owing to the constant agitation of the waves. An experiment in our laboratory has shown that any disturbance of sludge under water is undesirable from the standpoint of prospective odors.

Of the remedies at hand, dredging seems to be in general but a temporary expedient, aside from its value in cleaning up offensive conditions. It is temporary in the sense that the operation has to be repeated at intervals and does not offer any permanent relief in the intervening period when conditions may develop, according to the amount of dilution, which will produce nuisance. This might roughly be compared to the development of septic conditions in a sedimentation tank between the periods of cleaning. In the case at hand the periods are necessarily long. Unless a hydraulic suction dredge be used and large space be available for the ponding of the sludge, it may be difficult to remove all the material which should be classed as sludge. With a dipper dredge probably only the more gritty material

would be removed although conditions may be much improved thereby. The composition of sewage sludge, as found in sedimentation tanks of various types, ranges from a specific gravity of 1.01 to 1.06 and seldom exceeds 1.10, the water content running from 85 to 95 per cent. This is a material which is fairly liquid.

The only permanent remedy is to remove the sources of the trouble or prevent the formation of deposits. The construction of a bypass or an intercepting sewer and outfall may relieve the situation locally, and remove the discharge to a point where further attention may be required in the future. Local consideration will, of course, govern such action. To prevent deposits, the removal of the settling suspended matter is the key. The dilution available, however, may require further treatment. Today screening is available where the areas tributary are relatively small and the sewage fresh, and in case screening be not sufficient, various styles of sedimentation tanks either of the single or double deck type can be used to advantage. The sludge will be retained in them and in addition an improvement of the liquid made thereby of added benefit.

It is difficult to state any hard and fast criterion that will cover all cases. The amount of dilution affords one key. I would suggest, that where a stream is large and the dilution great, so that oxygen is always present to a high degree except in the vicinity of the sludge banks, dredging may prove an appropriate remedy. This is particularly true when the velocities of flow are sufficiently high to keep the settling material moving at other points. Possibly the deposits might be removed and their place filled with a fine, inert material, such as gravel or sand, in order to keep a uniform cross-section and to prevent the formation of banks in places of low velocity.

Where the oxygen content is low, particularly in the summer time, and even exhausted, it would seem as though the dredging of sludge deposits was at best but a temporary expedient and strictly of benefit only as a stream cleaning process, preparatory to putting in operation efficient settling tanks or screening devices which will remove the settling suspended matter. There lies the permanent remedy.

The question of cost is largely dependent on local conditions, and in many cases the relative costs of the methods outlined may not control, since conditions of nuisance frequently must be removed and prevented at any reasonable cost. Comparison, on the basis of the cost per cubic yard of dredging and of sludge collected in tanks, is difficult. Roughly speaking per cubic yard of material handled, dredging has the lower cost price. The total annual cost per cubic yard of sludge collected in a sedimentation plant, with Emscher tanks, would be considerably higher. The effectiveness and scope for application of sedimentation plants is, however, quite distinct from that of dredging.

The conclusions are:

1. Sludge deposits may form, when velocities of flow are low.

2. The effect of sludge deposits is governed somewhat by dilution. Nuisance may exist locally, even though the dilution be very great.

3. Sludge deposits will use up oxygen from the supernatant liquid.

4. Three remedies are available, dredging, bypassing the locality, and the removal of suspended matter before discharge.

5. Dredging is efficient as a cleaning-up process. It is not a permanent remedy, in that it may not reach all material, and is executed at infrequent intervals.

6. Bypassing the locality is a temporary expedient, which may relieve present conditions and perhaps cause trouble later elsewhere.

7. The removal of suspended matter by screening or sedimentation is effective, and of permanent service.

8. Screening will remove the coarser material, the results depending very largely on the character of the sewage.

9. Sedimentation will remove practically all the settling suspended matter.

10. Effectiveness and cost must be balanced to suit physical conditions.

SOME OBSERVATIONS ON THE FORMATION OF HYDROGEN SULPHIDE IN SEWAGE.

DR. ARTHUR LEDERER,

Chemist and Bacteriologist of the Sanitary District of Chicago.

Read before the Sanitary Engineering Section, American Public Health Association, Washington, D.C., September, 1912.

When sewage undergoes anaërobic decomposition it releases hydrogen sulphide gas in varying quantities, often sufficiently large to be noted by its characteristic odor. The odor ordinarily found at sewage purification plants is probably due in most part to decomposition products others than hydrogen sulphide, such as ammonia, indol, skatol, phosphine, methyl merkaptan, phenol, phenylacetic-, phenylpropionic-, acetic-, butyric- and valerianic-acids and other compounds. In a general way we are aware that absence of air will favor the formation of these malodorous products of putrefaction, while in the presence of air decomposition may go on without any odor whatsoever, ammonia and hydrogen sulphide being at once oxidized to nitrates and sulphates.

Hydrogen sulphide may be produced from protein by purely chemical methods, such as fusion with caustic potash or by bacterial activity. In sewages the formation of the gas is largely due to bacterial action on the protein matter, this formation being similar to the formation of free ammonia, but the oxidation of hydrogen sulphide seems to depend much more upon chemical influence than in the case of ammonia.

The formation of hydrogen sulphide in sewages as derived from inorganic sulphates, first thoroughly studied by Beijerinck[1], has been demonstrated on numerous occasions to be altogether of bacterial origin. Sufficient data are not available as yet to form a definite opinion on the importance of the development of hydrogen sulphide from inorganic sulphates in sewage disposal plants. Recently Barr and Buchanan[2] reported large quantities of hydrogen sulphide in three sewage disposal plants, in which the sewage was very rich in sulphates. A specific organism, similar if not identical to the Spirillum desulphuricans of Beijerinck, has been isolated by these observers. H. W. Clark[3] observed the reduction of sulphates in sewages and so have a few others. A typical sulphate reduction also takes place in the "biolytic" tank (modified Dortmund tank) at the sewage testing station of the Sanitary District of Chicago, but no specific

[1] Centr. Bakt. Parasitenk. 1895, Abt. II, vol. 1, p. 3.
[2] Iowa State College, Engineering Experiment Station, Bulletin 26.
[3] Report of the Massachusetts State Board of Health, 1903, p. 251.

organism has been isolated as yet. Specific organisms, taking part in the formation of hydrogen sulphide from sulphates were observed also by Zelinski[1], Letts[2] and Van Delden[3]. Holschewnikoff[4] isolated a bacillus—the *bacterium sulphureum*—which was in his opinion a sulphate reducer. He claims to have found an increase in hydrogen sulphide on the addition of sulphates, but quantitative proof is lacking. He also obtained a strong hydrogen sulphide reaction on the addition of thiosulphates. However, this is a common property of many other bacteria.

Zelinski's description of the *bacterium hydrosulphureum ponticum* is interesting, inasmuch as he claims that the sulphates were decomposed under anaërobic as well as aërobic conditions. Salkowski[5] in investigating the source of the development of hydrogen sulphide in urine states that it is possible that sulphates might be the source of its formation but certain conditions must exist, which he has not been able to elucidate. Huppert[6] admits that hydrogen sulphide can be formed at a fairly high temperature from sulphates in the presence of organic matter. Nadson[7] rather recently described a reduction of sulphates in the presence of peptone under anaërobic conditions employing pure cultures of proteus vulgaris. Hoppe-Seyler[8] ascribes the sulphate reducing property to methane in the status nascendi. Petri and Maassen[9] accepted nascent hydrogen as responsible for the reduction. Murray and Irwine[10] held that the reduction is due to the protoplasmic carbon of some microörganisms, which first forms sulphides. The sulphides are acted upon by carbon dioxide and hydrogen sulphide is eventually formed.

There are a number of sewage purification plants in this country in which sulphate reduction has been noted, but little work has been done on the causes underlying this interesting phenomenon. It is safe to conclude that specific organisms fill a very important part in the process and that the formation of hydrogen sulphide from this source is to be clearly distinguished from the hydrogen sulphide accompanying putrefaction. For practical purposes it is immaterial from which source the hydrogen sulphide is being derived inasmuch as it draws impartially on the available oxygen of the stream into which it is discharged. The nuisance due to sulphate reduction is particularly apt to occur in sewages rich in mineral sulphates, such as iron sulphate derived from pickling liquors. In one case the total

[1] Proc. Russian Phys. Chem. Soc., vol. 25, (5) 1893.
[2] Proc. Roy. Soc. Edinburgh, March 4, 1901.
[3] Centr. Bakt. Parasitenk. 1903, Abt. II, vol. 11, p. 81.
[4] Fortschritte Med. vol. VII, 1889, p. 201.
[5] Berl. klin. Woch. 1888, p. 722.
[6] Neubauer and Vogel 8th Edition p. 197.
[7] Handbuch der Technischen Mykologie, vol. 3, p. 126 (Omelianski's article).
[8] Z. physiol. Chem. 1886, vol. 10, 401.
[9] Arb. kais. Gesundh. 1893, vol. 8, p. 490.
[10] Trans. Roy. Soc. Edinburgh 1893, vol. 37, 496.

mineral sulphates in the crude sewage of the testing station in Chicago amounted to 23.2 p. p. m. of Sulphur (S), while the equivalent portion leaving the "biolytic" tank, in which sulphate reduction is marked, showed but 1.3 p. p. m. of S. On passing the effluent, which had the typical "rotten egg" odor, on to a sprinkling filter, the sulphates again increased to 7.6 p. p. m. of S. The filter was covered with a silk-like growth of beggiatoa, which are very rich in S granules and their oxidizing ability can be readily judged by the result spoken of. Similar results have been obtained on other occasions. The effluent of the sprinkling filter has been very rarely putrescible although the influent contained at times as much as 40 p. p. m. of hydrogen sulphide. The same sewage, which lost the greater part of the sulphates in the "biolytic" tank, showed only a slight reduction in the common, old style septic tank. The iron present has, of course, become combined with the generated hydrogen sulphide and the soluble sulphides so that there were but traces of iron left as a rule in the effluent of the "biolytic" tank, although at times for very short periods the sewage carried as much as 100 p. p. m. of iron (Fe) and more. The precipitation of the iron salt by the hydrogen sulphide resulted in an effluent, which was particularly clear and low in colloidol matter but on storage free sulphur precipitated shortly. The active reduction process in the "biolytic" tank is accompanied by and perhaps stimulates the reduction of organic nitrogenous and carbonaceous matter, as borne out by the analytical data obtained. Altogether the observation points conclusively to specific bacterial action.

It seems of interest to investigate the rôle which some well known sewage bacteria and pathogenic bacteria might play in the reduction of sulphates in sewages or artificial sulphate media. Experiments along that line have in the past been extremely disappointing except in the very few cases in which it has been possible to isolate or identify a specific organism hitherto unknown. Fitz[1] cultivated a large number of bacteria without getting a trace of reduction on adding sulphates. Rubner[2] observed that bacterial cultures in bouillon or peptone bouillon may actually increase the quantity of sulphates. In some of his experiments the sulphates remained intact. In other cases the sulphates became diminished until they could not be determined but the decrease was not accompanied by the formation of hydrogen sulphide. The presence of sulphates did not seem necessary, however, when organic sulphur was present.

After experimenting with a large number of artificial media containing sulphur in the form of inorganic sulphates exclusively, I decided on a medium containing ammonium tartrate 10 gms., glucose 10 gms., basic potassium phosphate 1 gm., calcium chloride traces, sodium sulphate

[1] Chem. Berichte, vol. 12, p. 480.
[2] Arch. Hyg. vol. 16, p. 53.

10 gms. dissolved in 1 liter of water (medium "A"). Another medium employed (medium "B") had the same composition except that 50 mg. of glucose were added instead of 10 gms. It is claimed that if glucose is present in too large quantities, butyric acid fermentation may set in and the hydrogen sulphide reaction may be either absent or very much delayed. As a matter of fact there did not seem to be any noticeable difference in the sensitiveness of the reactions obtained with those two media during my experiments, but where one medium has been employed, "B" was the one resorted to. Some media, containing peptone in addition, have likewise been employed by me. They showed decided hydrogen sulphide formation on incubation with loopfuls of crude sewage, tank effluents, and sludges at either room temperature or at 37° C. This hydrogen sulphide formation is not the reaction of any specific organism, but the mass action of all bacteria preying upon the organic sulphur present in the peptone. Such decomposition is easily accomplished as will be noted later. The tests were qualitative only. However, the same amount of medium and the same size of loop were employed, so that a quantitative comparison of the results is justified. The hydrogen sulphide formation was observed in the first series of tests by inserting strips of filter paper, previously immersed in sterile lead acetate solution, into test tubes, the paper being fastened to the cotton plugs. A little glycerine was used in the preparation of the lead solution, so as to prevent the strips from becoming completely dried out on incubation.

The following cultures were used for incubating the various media: B. coli, B. typhosus, B. enteritidis, B. lactis, aërogenes, B. megatherium, B. mesentericus, B. claocæ, Proteus vulgaris, B. acidi lactici, Proteus Zenkeri, Proteus mirabilis, B. mycoides, Sewage streptococcus, B. ochraceus, Strept. mitus, B. pyocyaneus, B. fluor. non-liquefaciens, B. choleræ suis, rose red coccus, B. prodigiosus, Staphyloc. pyogenes albus, B. anthracis, B. dysentery and B. subtilis. One loopful of these cultures, grown on nutrient Agar, was inoculated into 10 c.c. of the sterile media "A" and "B," containing sulphur in no other form but the inorganic. The cultures were incubated aërobically at 37° C.

Both media gave a negative result with every one of the species except B. cloacæ. B. cloacæ showed a slight but distinct quantity of hydrogen sulphide on the rim of the lead acetate paper, after four days incubation. The liquid showed a decided bacterial growth. B. pyocyaneus and B. fluor. non-liquefaciens also gave a decided growth but no hydrogen sulphide. B. subtilis showed a distinct surface growth and likewise no hydrogen sulphide. A blank experiment was made in each case with sterile tap water as the medium. Chemical tests proved the absence of organic sulphur in the various ingredients employed in making media "A" and "B." Four strains of B. cloacæ were used at one time or another but a positive

hydrogen sulphide reaction has not always been obtained. Aërobic incubation gave 9 positive and 5 negative results on 3 to 10 days' exposure. Anaërobic incubation gave 4 positive and 3 negative results on 1 to 2 weeks' exposure. Thirty-seven degrees C. proved more favorable than 20° C. or room temperature. Whenever a reaction failed there was either no growth at all or very little growth noticeable. In positive cases, the longer the exposure the more distinct the reaction developed, but even in the most favorable cases the quantity could hardly be called anything but distinct traces as compared to the amount of hydrogen sulphide generated by a culture of B. cloacæ in a 10 per cent. peptone bouillon solution.

Quantitative investigation to prove an actual reduction of sulphates has not been undertaken. It is doubtful whether such an investigation would even prove successful, since there were never more than traces of hydrogen sulphide formed and unavoidable working errors might have resulted in differences possibly larger than the true differences. Inoculations of B. cloacæ into sterile tap water never resulted in hydrogen sulphide on incubation. I believe that the hydrogen sulphide formation in this case was not due to a sulphate reduction analogous to the reduction occurring with the Spirillum of Beijerinck, but rather that a small part of the mineral sulphate became converted into organic sulphur in the bacterial body, which on decomposition released hydrogen sulphide. It is very likely that some common forms of sewage bacteria take a part in the formation of hydrogen sulphide from the mineral sulphates under specific conditions, which have as yet not been reproduced artificially.

Where the reduction is as marked as in the "biolytic" tank, spoken of before, there can be hardly any doubt of specific action. When I incubated medium "B" under aërobic conditions with a loopful of the sludge from that particular tank, I obtained in a few hours a decided hydrogen sulphide reaction on lead acetate paper. The sludges from two other septic tanks gave a weak reaction in the same period and the sludge from a plain settling tank showed no reaction at all. When the incubation was extended from one day or longer all sludges showed a strong hydrogen sulphide reaction. The sludge from the "biolytic" tank, incubated under anaërobic conditions also gave a distinct reaction in medium "B."

It is also interesting to note that a number of the common sewage bacteria largely retard the oxidation of the black iron sulphide in sewage sludge. Test tubes containing a sterile medium consisting of 10 per cent. sludge in sewage were inoculated with loops of B. coli, B. typhosus, B. enteritidis, B. megatherium, B. mesentericus, B. cloacæ, Proteus vulgaris, Proteus Zenkeri, Proteus mirabilis, B. mycoides, B. pyocyaneus, B. fluor. non-liquefaciens, Staphyloc. pyogenes. albus and B. subtilis. The tubes were incubated aërobically at 37° C. Soon the blank, containing the sterile medium began to change. The black iron sulphide gradually became con-

verted into brown basic sulphate from the top downward. In one week all of the black color had disappeared. The B. cloacæ, B. pyocyaneus, B. fluor. non-liquefaciens tubes, after that time, still showed the black color throughout, but the B. cloacæ sludge began to show signs of oxidation on the surface. Other species showed this effect to a much lesser degree. With some species, as B. megatherium and B. mesentericus, the oxidation proceeded nearly as quickly as in the blank sludge. One c.c. of sewage, one loopful of river mud, sludge from the "biolytic" tank, septic tank and settling tank added to test tubes containing the medium prevented the oxidation of the sludge as long as they were under observation (ten days). However, 1 c.c. of fresh lake water added to the sterile medium quickly changed the black color into brown. As a matter of fact, the lower tube was completely oxidized. Werigo[1] incubated oxidized sterilized mud from the coast of the Black Sea with small amounts of non-sterilized black mud. The gray color of the oxidized material quickly changed to its original black. The black color was due to the presence of iron sulphide. Philippowitsch[2] and Brussilowsky[3] observed that the blackening of that particular sterilized mud took place on incubation with the water from the coast and even river water. They did not consider this reduction process as due to specific bacteria. B. phophorescens and B. typhosus likewise gave a black color in the mud on inoculation.

The question arises as to whether in a sewage purification plant an effluent in which an active sulphate reduction takes place should be looked upon as more putrescible simply because it contains more hydrogen sulphide or not. The old Hamburg putrescibility test, which consisted of the determination of the organic sulphur in the sewage effluents, did not take the inorganic sulphate reduction into account. Possibly the formation of hydrogen sulphide from sulphates is more general than is supposed. I believe a distinct mistake would be made if the sulphates are disregarded. Fortunately Spitta and Welder's methylenblue test permits the normal and abnormal biological processes to proceed on a small scale. The reducing compounds, formed, react no matter what their source may have been. The Hamburg putrescibility test assumed that organic sulphur is the main source of the putrescent decomposition products. Under ordinary conditions, the hydrogen sulphide, released during the putrefactive process in a sewage purification plant, is hardly noticeable and can be detected in the majority of cases only by sensitive, chemical tests. Yet its development is general and proceeds continuously, just as does the conversion of highly complex nitrogenous matter into free ammonia.

That organic sulphur in protein bodies constitutes a source of hydrogen

[1] Congress internat. d'hydroth. et de climat. Biarritz 1886.
[2] Wratch 1887 No. 16.
[3] Wratch 1890 p. 717.

sulphide gas has been known for a long time. Petri and Maassen[1] observed this phenomenon with the B. erysipelatus suis. The work was originally undertaken by these authors with the view to establish, if possible, the relation between the formation of hydrogen sulphide and hog erysipelas, but it has since been found that practically all known bacteria form hydrogen sulphide from protein compounds under certain conditions. The ability to form hydrogen sulphide will largely depend upon the amount of organic sulphur present. The authors mentioned employed a large number of species, most of which were pathogenic to animals. All of the species formed hydrogen sulphide. Rubner[2] also took a large number of cultures and inoculated them into extracts from the thymus, lung, liver and spleen, from which the inorganic sulphur had been removed. Hydrogen sulphide has been obtained whenever the growth was strong. Thus, he proved that the sulphates were not necessary for the formation of the gas. He disagreed with Petri and Maassen on the cause for the hydrogen sulphide development. Rubner concluded that the formation of hydrogen sulphide is not a secondary reduction process, due to the formation of nascent hydrogen, contrary to the belief expressed by the other two authors. Stagnitta —Balistreri[3], on working with twenty-three various species of bacteria, found that forty per cent. of them gave hydrogen sulphide in peptone bouillon and plain bouillon. He tried to obtain some quantitative data by comparing the extent of the color on lead acetate paper to the color of the papers exposed to known quantities of hydrogen sulphide. Petri and Maassen found that the addition of sulphates and thiosulphates will also result in the development of hydrogen sulphide. With regard to the thiosulphates this has also been observed by Rosenheim and Gutzmann[4].

It has been stated that bacteria can not be classified as hydrogen sulphide formers and non-hydrogen sulphide formers, as was first supposed. On addition of 10 per cent. peptone bouillon to ten species, which had not reacted in bouillon containing less peptone, Petri and Maassen obtained a strong hydrogen sulphide reaction.

I undertook to incubate the species, employed during my work, previously mentioned, in media containing sulphur in various forms and found in a general way that the results coincided with the results of former observers. A medium of the same composition as medium "A" but containing sodium thiosulphate instead of sodium sulphate gave more or less hydrogen sulphide in each case on aërobic incubation at 37° C. In a few cases the quantities were so small as to be hardly perceptible on lead acetate paper. Sulphur added to sterile sewage formed hydrogen sulphide

[1] Arb. kais. Gesundh. 1893, vol. 8, p. 318.
[2] Arch. Hyg. vol. 16, p. 53.
[3] Arch. Hyg. vol. 16, p. 10.
[4] Fortschritte Med. 1887, No. 11.

aërobically with all species except B. lactis aërogenes, Proteus Zenkeri, Proteus mirabilis, B. pyocyaneus, Staphyloc. pyogenes albus, B. anthracis, B. dysentery and B. subtilis. It is very likely that the number of positive tests would have been greater if more time had been allowed for incubation. Plain bouillon gave a decided reaction only with B. enteritidis, Proteus vulgaris and traces with B. mesentericus. The rest proved negative on aërobic incubation for over one week. Lactose bouillon gave a strong growth with B. enteritidis and Proteus vulgaris. A few species showed traces of hydrogen sulphide in bouillon containing 10 per cent. peptone (reaction +1). All cultures gave a hydrogen sulphide reaction sooner or later on aërobic as well as anaërobic incubation.

On repeating the experiments with 10 per cent. peptone bouillon several times, it was interesting to note that the strong hydrogen sulphide formers gave a strong reaction throughout the entire series, while species giving weak reaction would on repetition always prove weak in the same length of time.

I am not inclined to attach very much significance to this quantitative difference in the behaviour of the bacteria towards the organic sulphur in peptone though it might prove valuable to classify the various species distinctly as to their hydrogen sulphide forming properties. This can be done, providing, certain standards are adopted for time of incubation, the uniform composition and reaction of medium, temperature of incubation, age of culture, etc. The virility of the culture is a factor of great importance. A rejuvenated culture will show hydrogen sulphide sooner than an old stock culture. Care was taken, therefore, to employ fresh cultures throughout the tests.

In order to gain some information on the hydrogen sulphide forming properties of crude sewages in such a peptone medium a few quantitative experiments were made, which are given in the following:

A 10 per cent. peptone bouillon was prepared and 1 c. c. of an approximate 10 per cent. sodium sulphate solution was added to each test tube to allow for a possible sulphate reduction. The quantity of medium in each test tube was exactly 15 c. c. A quantitative determination showed that the test tube contained 12.0 mg. of organic sulphur and 86.9 mg. of sodium sulphate anhydrous. Each test tube was provided with a tight fitting rubber stopper. The upper part of the thistle tube with a double bend fitted into the stopper and some absorbent cotton moistened with a saturated solution of basic lead acetate with 5 per cent. of glycerine was plugged into the funnel, so that all hydrogen sulphide formed would be bound chemically. One c. c. of crude sewage was added to the medium and the mixture incubated aërobically as well as anaërobically at 37° C. for exactly twenty-four hours. The test tube was then put into warm water to drive out any gaseous hydrogen sulphide in solution. The cotton plug and the

incubated liquid were washed into an Erlenmeyer flask and the liquid acidified with sulphuric acid in order to release the hydrogen sulphide bound in the form of sulphides. The liquid was then distilled and the distillate received in a N/100 silver nitrate solution. The distillate was made up to 100 c. c. thoroughly shaken, filtered and 50 c. c. of the filtrate titrated with N/100 potassium sulpho-cyanate solution, using ammonio-ferric-sulphate solution as an indicator.

Two tubes containing the sterile medium were incubated and served as blank tests. There is always some hydrogen sulphide split off even from a 10 per cent. peptone solution on mere boiling. It is, therefore, absolutely necessary to run blank tests. The average of the blank tests showed that 15 c. c. of the sterile medium distilled with the acid under the same conditions as the inoculated cultures gave about 0.33 mg. of hydrogen sulphide. The sterile medium incubated for twenty-four hours and then distilled as before gave on an average 0.39 mg. of hydrogen sulphide or an excess of 0.06 mg. over the direct distillation. The figures remained the same for aërobic as well as anaërobic incubations. The hydrogen sulphide figures in the following table represent the gas with the blank subtracted. Very good checks have been obtained in each case for the blanks as well as for the inoculated media.

Sewage Ser. No.	Total suspended matter p. p. m. (sewage).	Oxygen consumed p. p. m. (sewage).	N as free ammonia p. p. m. (sewage).	N as organic nitrogen p. p. m. (sewage).	Relative stability (sewage).	H_2S developed aërobic mg. (medium).	H_2S developed anaërobic m. g. (medium).
1	296	60	5.6	6.9	29*	0.95	0.95
2	134	59	8.8	9.6	26*	1.04	1.08
3	88	24	6.4	8.8	53*	0.77	0.91
4	106	—	8.4	6.8	56*	0.67	0.90
5	90	28	8.8	8.0	64*	1.06	1.13
6	142	56	5.6	9.3	29†	1.01	1.05
7	106	58	8.4	8.1	29‡	0.94	0.91

* Dilution: 1 sewage to 3 lake water.
† Dilution: 1 sewage to 4 lake water.
‡ On incubation for twenty-four hours at 37° C. in 10% peptone bouillon containing sodium sulphate.

The results indicate that under anaërobic conditions, the quantity of hydrogen sulphide formed is somewhat larger, particularly in sewage No. 4. Apparently the other data obtained do not bear a distinct or definite relationship to the amount of hydrogen sulphide developed. This is to be expected since we know that the formation of hydrogen sulphide in sewages or in proper artificial organic solutions is a specific property of the

bacterial cell body. The action is selective and depends apparently a great deal upon the position of the sulphur radicles in the protein molecule of which we know little. A bacillus may be a strong nitrate reducer and yet a very weak hydrogen sulphide former, although both processes are reduction processes.

The subject of putrid odors in sewages is a highly complicated one. I have spoken of one phase only, viz: the formation of hydrogen sulphide in its relation to inorganic or organic sulphur compounds, but we must also consider that other organic volatile sulphur compounds are likely to be formed, which from a practical working standpoint might prove troublesome.

The writer wishes to express his appreciation of the valuable continuous assistance of Mr. Frank Bachmann, assistant chemist of the Sanitary District, in the work necessary for the preparation of this paper.

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UNIFORM HEALTH REPORTS.

Health officers and others who have occasion to study and compare the annual reports of health departments find the task difficult, and not infrequently impossible. No definite scheme is followed in most instances and the reports do not give the information sought or if it is given it is apt to be so obscured as to be worthless. It is certain that health reports are undergoing a marked improvement, and it may be said that in general the improvement is for the better.

There is much information in the annual health records capable of uniform treatment. It must be recognized, to be sure, an annual report is presented primarily for the benefit and information of the officers of the city government and its citizens. Nevertheless, the out-of-town circulation is considerable and growing, and the up-to-date health officer is endeavoring to study the methods used, and the results obtained

thereby, in other communities. There are many apparent reasons why uniformity in certain respects is to be desired.

More than two years ago, the Massachusetts Association of Boards of Health appointed a special committee on Uniform Health Reports. This committee presented its report at the last meeting of the association, and is printed in full elsewhere in this issue of the JOURNAL. It is believed that health officers throughout the country will find much in this report of interest and value and that it warrants a most careful perusal. The committee, while recommending a certain degree of uniformity, strongly warns against the danger of too great a uniformity and states that "if greater uniformity in reports should encourage the health officer in complacently following the routine practice of other communities, it would be better to allow the present confusion to continue."

The committee had a difficult and exacting problem but it has handled it in a very thorough and satisfying manner. We believe that this kind of work is of the greatest importance. It is not of application alone in Massachusetts. It should cause health officers everywhere to stop and take stock of their own reports and study them from the point of view of improvement and uniformity.

THE CONTROL OF CANCER

Still another scourge of man has called forth a movement to combat it. This latest recruit in the public health field is the American Society for the Control of Cancer. The new association is unique in that it is attacking a disease the cause of which is unknown and regarding which the ignorance is profound. Its specific task is the education of the public to the recognition of the significance of certain symptoms and the necessity for early diagnosis and operation. As in the case of many of its sister societies, the initiative has been taken by leading members of the medical profession in America who have called to their side interested laymen to insure the efficiency and success of the movement. It is understood that the pathology of cancer will not be regarded as falling within the field of the new society, but in addition to public education, careful studies will be made of the incidence and distribution of the disease as well as of the results of operative procedure. Ignorance of causation naturally renders the cancer problem more baffling than that of tuberculosis, or the other preventable diseases which the civilized world is now engaged in fighting. For that reason there is, perhaps, the greater need of initial steps and we welcome the new organization to the group whose activities give vigor to the great public health movement of the day.

PRACTICAL AND JUST LEGISLATION RELATING TO STREAM POLLUTION.

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Read before the Sanitary Engineering Section, American Public Health Association, Washington, D.C., September, 1912.

To discuss intelligently the question of practical and just legislation relating to stream pollution, there is necessary a thorough knowledge of the nature of streams and the numerous uses made of them under present day conditions, as well as a clear understanding of the sources and results of pollution, and the means available for minimizing its effect on the streams, and, where necessary, bringing about its prevention.

Streams perform the double function of supplying water to riparian owners and draining the territory through which they flow. They are used for power development, for navigation, and for irrigation. Certain fish industries are dependent upon them, and in modern communities the streams are serving more and more as centers of health and recreation. The relative importance of the several uses made of streams varies with local conditions.

Even in nature river water is seldom "pure," and in populated areas it contains drainage of all sorts:—from undeveloped areas, from farm lands and fertilized fields, from country roads and from city streets. Mine drainage is discharged into the streams, as well as wastes of all kinds from manufacturing establishments, and finally, domestic sewage from individual houses, from shipping, and from communities, small and large. The water often becomes colored and turbid, and may have an objectionable odor if it contains large quantities of easily putrescible organic matter. Disease germs are sometimes present, and the insoluble matters carried in suspension often deposit on the bed and banks. It is thus evident that the question of pollution is one of *degree*, also, that distinction should be made between avoidable and *unavoidable* pollution. The degree of pollution *permissible* is largely determined by the *use* made of the stream, while the extent to which pollution becomes *noticeable* depends on the population contributing sewage and manufactory wastes, the natural character of the water and the volume available at all times for dilution, the frequency and magnitude of flood flows, and the character of the river channel with respect to alignment, grade and natural or artificial obstructions to the free flow of the water.

The present rapid growth and congestion of population, accompanied by the increased variety and volume of liquid wastes from industrial

plants, has brought many of our rivers to a very serious condition, while the numerous uses now made of them render necessary *some* form of legislative control. The *necessity* for such control is increased by the lack of relation between political boundaries and natural drainage areas, by the inability or unwillingness on the part of individuals and communities to provide and maintain suitable works for the treatment of polluting matters, and to the fact that the parties responsible for the pollution of a stream are often those who would be the least benefited by keeping it clean.

To a considerable extent streams clean *themselves* through natural agencies:—such as sedimentation, aëration and consequent oxidation of easily putrescible organic matters, and the removal and disposal of sludge deposits by freshets and currents. *Artificial* means which may be employed for maintaining rivers in an unobjectionable condition include (1) their regulation, from a hydraulic standpoint and with a view to providing uniform flow, straight channels, good grades and smooth beds,—(2) the dredging of deposits,—and (3) the collection and treatment of polluting matters *previous* to their discharge into the streams. The efficiency of the *natural* agencies, as well as the applicability of the various *artificial* means of bringing about the desired results, depends in each case upon local conditions; the degree of cleanliness actually *practicable* being controlled largely by cost. River cleaning must also be considered in its proper relation to *other* branches of municipal activities.

There are some streams located *entirely* within the political boundaries of individual states, and others whose drainage areas extend into two or *more* states. A *few* of our streams also constitute international boundaries, and there is a further distinction between tidal or navigable waters, and the *un*navigable portions of streams. The national government, through the War Department, very properly exercises a certain control over tidal and navigable waters. The states, in some instances acting through their boards of health or specially appointed commissions, attempt to prevent the serious pollution of streams within their boundaries. River control and regulation has also been undertaken in some metropolitan districts as well as in individual municipalities, and in many instances much of good has been accomplished. But on account of the fact that the supervising officials often have very little *real* power, and because their supervision seldom extends over *entire* drainage areas, the results are not all that could be desired.

It is therefore important that steps be taken to provide suitable legislation looking to the maintaining of our streams in a reasonably clean condition, and as there would be many advantages in having such legislation more or less uniform throughout the country it might be made subject to the approval of some national governmental agency.

It is *not* desirable to have laws prescribing the exact degree of cleanliness to be maintained, because the proper degree will differ for each set of con-

ditions, and because the cleanliness of the water is only one phase of the general problem.

Legislation *should* provide for boards of control having power to determine, in each individual case, the limits of permissible pollution. It should also define the methods of appointment, or election, of such boards, their membership, powers, and duties, and their relation to existing governmental agencies, as well as determine how money shall be raised for carrying on their work.

The boards of control may be advisory and supervisory with police authority like many of the existing state boards of health, the actual construction and operation of works being left to individuals and municipalities, or they may have complete power to raise money and to build and maintain works of all kinds, like the Sanitary District of Chicago and the Emscher Federation of Germany. The relative advantages and applicability of the two types will vary with local conditions.

The Emscher Federation is, in many respects, the most interesting river board now in existence, and as six years of operation have proved that it is founded on correct principles, the author presents a translation of the statute under which the Federation works, as well as a description of the conditions in the drainage area of the Emscher River and an account of the work accomplished.

THE EMSCHER FEDERATION.

Conditions in the Emscher District previous to the Formation of the Federation.

The drainage area of the Emscher River is located in the heart of the coal and iron industrial district of western Germany. It covers an area of 308 square miles and has a population of about 2,000,000. Essen, the largest city in the district, now has nearly 300,000 inhabitants, an increase of more than 100 per cent. during the past ten years; while ten of the other municipalities have a population of more than 50,000 each. The average density of population for the entire drainage area is approximately 6,500 per square mile.

Some of the coal lands are still undeveloped, but they are being opened up year by year, so that the present rapid increase in population is likely to continue, and the conditions, from a sanitary standpoint, would naturally become worse rather than better.

The main stream has its source in the vicinity of Dortmund, and flows in a general westerly direction for a distance of 68 miles to the Rhine which it joins at a point 50 miles below Cologne and 125 miles above Rotterdam. The total fall in the course of the Emscher is nearly 400 feet; but there are long stretches where the bed of the river has practically no slope and the velocity of flow is slight. Some of the land in the district is under cultivation. The soil is rather impervious, however, and wooded areas are not extensive, so that there would naturally be a small flow in the streams during dry weather. Practically no ponds or storage reservoirs are to be found within the watershed. On the other hand, the rainfall (approximately 30 inches annually) is distributed uniformly throughout the year, and the normal yield of the watershed is increased by the sewage of some cities which obtain their water from other drainage areas. Water is also discharged into the river from coal mines, of which a number are located close to the limits of the district, being pumped out of the ground from depths varying from 500 to 2,500 feet.

The coal-mine drainage constitutes under present conditions a little less than one third of the total flow of the stream, while the sewage from the various municipalities forms an equally large proportion of the river. The average quantity of water flowing in the Emscher at its mouth is approximately 318 cubic feet per second, or 667,000 gallons per square mile of watershed per day. The minimum average flow during any one month is ordinarily not less than 191 cubic feet per second, as compared with a minimum flow in the Rhine, where it receives the discharge of the Emscher, of 30,420 cubic feet per second (from 59,500 square miles).

Ten years ago when the sanitary conditions in the Emscher district began to be seriously considered, only a small part of the population was provided with adequate sewerage facilities. Two of the cities had complete systems of sewers, one, the combined system, with disposal of the sewage by broad irrigation outside of the drainage area, the other, a storm-water system only, which however, received much pollution from house cesspools, with disposal by chemical precipation and ultimate discharge into a tributary of the river. In those municipalities not provided with sewers the brooks were seriously polluted by sewage and trade waste of all kinds.

The coal-mine drainage carried in suspension large amounts of fine coal dust, which settled out where the current in the river was slight. At some of the mines this drainage was passed through settling tanks before being discharged into the river, but as a rule the tanks were so poorly designed and operated that they were not effective in keeping the coal sludge out of the stream. Iron works and factories of all sorts contributed in similar ways to the pollution of the water.

Another important factor in the situation was the gradual sinking of the ground in many sections above the coal mines. Such settling along the course of the stream led to the formation of extensive shallow basins, which gradually became filled with coal sludge and other refuse, thus bringing about extremely unsanitary conditions.

The odors rising from the brooks and flooded areas were very objectionable, while much of the land was unsightly and so poorly drained that it could not be used for agricultural purposes and had become a breeding place for mosquitoes. Fortunately there is seldom continued hot weather or drought in this section of Germany so that the nuisances were not as bad as they might have been.

Conditions were steadily becoming worse, however, and with the rapid increase in population, it became imperative to take steps to abate the nuisances then existing and to provide proper sewerage and drainage for the entire district.

How the Emscher Federation was Brought About.

The Prussian Government had already ordered the cities and large towns in the valley to provide proper sewerage, without stating definitely what disposition was to be made of the sewage. In 1902 a number of the municipalities and industrial corporations, most affected by the condition of the river, joined forces to form an association for making a thorough investigation and outlining a plan of action. During the following two years all phases of the general problem were carefully studied by experts. The report of the chief engineer, Königlicher Wasserbauinspektor Middeldorf, was presented to the association on January 1, 1904. It contained, in addition to a description of the existing conditions, a comprehensive plan for the construction of sewers, purification plants and improved channels for the river and its tributaries; together with the draft of a bill to be presented to the Prussian Government for creating a permanent Federation and board of control to have charge of the undertaking.

The work to be done by the Federation, as indicated by the investigations, may be briefly outlined as follows:—

1. To compel the cities and towns to provide and maintain proper drainage and suitable sewerage systems, for house sewage, for liquid wastes from manufacturing establishments and for surface water; to compel the discharge of manufacturing wastes, after preliminary treatment where necessary, into the sewers instead of the streams; to abolish cesspools, not only as a

means of preventing local nuisance but for the purpose of keeping the sewage as fresh as possible.

2. To design, to construct, and later on to maintain and operate main sewers common to two or more municipalities, as well as all necesssary pumping stations and disposal works for treating the sewage. The term "disposal works" may here be considered to include clarification plants for the treatment of coal-mine drainage.

3. The largest and perhaps most important part of the work consisted in regulating the main stream so that the entire valley would be well drained at all times. This involved relocating the river throughout much of its course, relining, enlarging and deepening the channel of the river and many of its tributaries, and draining flooded or swampy land. From the start it was evident that it would not be feasible to provide complete biological treatment for all sewage and manufacturing wastes. It thus became essential for the streams to have good grades as well as smooth and regular channels in order that there might be no opportunity for accumulations of objectionable deposits.

The total cost of the undertaking was originally estimated to be in the vicinity of $15,000,000; two thirds of which would be spent for the improvement of conditions along the course of the river, the remainder being for the construction of main sewers and disposal works. This was a task requiring not only the best engineering skill for its execution but power to raise and spend money and to exercise a very complete control over conditions in a large district.

The Statute: A Translation and Explanation.*

Membership.

The law creating the Emscher Federation was enacted by the Prussian Government, on July 14, 1904, and supplemented by a Statute on March 19, 1906. The Statute provides that the Members of the Federation shall be all existing municipalities, both urban and rural, and totaling more than 100, which drain partly or wholly into the Emscher River or its tributaries. Municipalities within the drainage area, created subsequent to the passage of the law, shall also be members of the Federation. The magnitude of the work to be undertaken as well as the serious character of the existing conditions rendered it desirable that the Federation should be compulsory upon those municipalities who showed no interest in joining.

In addition to the "Members" of the Federation, reference is made in the Statute to so-called "Interested Parties" such as the Mines, the Railroads, and other industrial Plants and Factories located in the several municipalities. The Interested Parties are represented indirectly in the Federation and bear part of the expense of building and maintaining the federation works.

It might be mentioned here that the state of Prussia is divided into Provinces each of which contains a number of Districts within which are located the urban and rural Municipalities. The Emscher district is located in the Rhine province and the province of Westfalia.

Purpose and Powers.

The purpose of the Federation, as explained in the Statute, is to provide for the regulation of the streams in the drainage area of the Emscher river and for the treatment of the sewage, as well as for the maintenance and operation of the completed works. That the Federation shall maintain and operate the completed works is particularly desirable, since settling of the ground above the mines results in the necessity for frequent repairs and alterations. The various works are in general based on a preliminary design prepared by Middeldorf in 1903, but the original scheme has been altered or extended, with the approval of the proper government officials, as found desirable.

*Made by the author and Richard H. Gould, Asst. Eng. with the Emscher Federation, Essen, Germany.

The Federation has the power to take charge of treating the sewage and trade waste of the mines and industrial establishments, as well as that of the municipalities. In numerous cases, however, it has been found desirable to leave it in charge of the individual party. At many of the coal mines, for example, the owners are interested in reclaiming and using the coal dust in the waste water. If the treatment of trade waste, however, is not carried out in a satisfactory manner, the Federation may assume full control, and assess on the owners the cost of building and operating suitable works. All works, whether built and maintained by the Federation or by individuals, are operated under regulations made by the Federation.

In many respects the Federation possesses the same rights as a municipality. It has full control over all water courses in the drainage area and can make such alterations, both in location and elevation of the channels of the streams, as prove desirable, irrespective of highways, railways, or canals. It may assume financial obligations and exercise the right of eminent domain, taking and holding what land is necessary for carrying out its works. If a satisfactory agreement as to price cannot be made with the owners, the matter is referred to the courts.

The working bodies of the Federation are the Federation Assembly, the Executive Committee and the Protest Commission.

Relation to Existing State Officials.

The Federation comes under the supervision of the State, which is comparable with our national government, the supervising official being termed "Supervisor." The Supervisor must be a "President" of a Province, and he is appointed by the head ("Minister") of one of the state departments.

There is a state department of Agriculture, Public Works, Industry and Commerce, Interior (including a Board of Health) and Education. Particularly unsanitary conditions at any point in the state are investigated by a special commission of representatives from each of these departments.

The Supervisor's powers are limited to seeing that all federation matters are handled in compliance with the Statute. His definite approval is required for the making of loans which permanently increase the federation debt, and for regulations relative to the "Apportionment of Federation Expenses," and to the use and maintenance of the federation works. He calls together the first Federation Assembly after preparing a temporary "Apportionment of Expenses" as a basis for representation of the Members, and he may, when he sees fit, call special meetings of the Assembly. If valid elections of members of the Executive Committee and Protest Commission are not held when they should be, the Supervisor makes the necessary appointments, and if the Federation fails to meet its financial obligations, he may raise the necessary money and pay the bills. Against such action on his part the Federation may appeal to the superior courts of the State.

Presidents of the Provinces, and the Districts may attend meetings of the Federation Assembly and the Executive Committee and give advice, and the State Bureau of Mines has the same privilege. The Statute provides that they shall be notified of all meetings and furnished with information relative to the subjects to be discussed at the meetings.

All general and detail construction plans of federation works must be approved by the local municipal building officials, by the officials of the District, and by the proper state departments, but the law says nothing about the methods to be adopted for either river regulation or sewage purification.

Federation Assembly.

The Federation Assembly consists of Representatives elected every six years by the legislative bodies of the federation Members, the number of Representatives depending in each case upon the amount contributed by the Members towards the federation expenses. The elections

are arranged in such a way that the newly elected Representatives form only a small proportion of the total number in the Assembly. All the Representatives have substitutes. Each Member sends at least one Representative. When the annual contribution of a Member exceeds $3,750, the Member may send a second Representative, and for each additional annual contribution of $3,750, a further Representative. If a Member sends two Representatives to the Federation Assembly, one of them must be connected with the mines. Furthermore, if a municipality which sends 10 Representatives, receives 50 per cent. of its taxes from the mines, then 5 of the Representatives must be connected with the mines.

Disputes as to the validity of the election of Representatives are decided by the Supervisor, with right of appeal to the proper (state) Minister. If a federation Member fails to elect its Representatives, they are appointed by the proper state officials. Representatives have the privilege of voting by written proxy when they are unable to attend the meetings of the Assembly. They lose their right to vote if they change their residence to a point outside of the Emscher drainage area.

According to the law it is compulsory on the Federation Assembly to meet at least once during the period for which the Apportionment of Expenses is made. Special meetings may be called by the Supervisor or by the Executive Committee, and must be called at the request of one quarter of the Representatives. The principal duties and powers of the Assembly are as follows:

Elect the members of the Executive Committee and the Protest Commission.

Approve the general principles governing the appointment and service of employees.

Assume the power to borrow money.

Determine rules and regulations relative to use and maintenance of the federation works.

Decide on the length of the period for which the Apportionment of Expenses is to be made.

Approve the Budget prepared by the Executive Committee.

Determine the proper expense accounts for members of the Executive Committee.

Decide as to alterations and extensions of the general plan of the federation works.

Change, when desirable, the Federation Statute, subject to the approval of the proper (state) Minister.

Arrange for dissolution of the Federation, should this become desirable. Dissolution calls for a two-thirds majority of the Representatives and the approval of the King of Prussia.

The Assembly must keep written records of its proceedings. The meetings are public, but the "publicity" may be waived when desired.

Executive Committee.

The Executive Committee is the legal representative of the Federation and attends to all federation business which is not expressly referred, by the Statute, to the Federation Assembly. It is composed of 10 members, one of which is the chief engineer of the Federation. The other nine members are elected by the Assembly to hold office for six years. One-third of the elected members retire every two years, but are eligible for reëlection. The Statute states that three members of the Committee must belong through residence to the Rhine Province, and four to the Province of Westfalia. At the same time, the Mines, the other Industrial Plants (including the Railroads), the Agricultural Interests, and the Municipalities (taken as a whole) each have at least one Representative on the Committee.

A sanitary expert, employed by the Committee, is present at the meetings, which are called at the pleasure of the chairman, or upon request of three of the members. The committee meets on an average of about once each month, six members constituting a quorum. Disputes relative to the validity of the election of members of the Committee are decided by the state Supervisor with right of appeal to the proper Minister. Written records must be kept of the proceeds of all meetings.

The Executive Committee appoints the chief engineer and other federation employees and prepares regulations governing the appointment and conditions of service of the employees. It may also appoint special commissions for special work.

Its chief functions, however, are the preparation of the annual Budget, keeping the accounts, and apportioning, among the Federation Members and Interested Parties, the expenses connected with the construction and maintenance of the federation works. It is expressly stated in the Statute that the first annual Budget shall provide, principally, for the regulation of the main river, and the Committee is given the power to determine at what time money shall be raised for regulating the tributary streams and providing Sewage Disposal Works. If protests are raised within four weeks to the Apportionment of Expenses, they are taken under consideration by the Committee, which may then alter the original apportionment. The changes thus made, with the reasons therefore, are sent to the Parties who have made the protests.

Apportionment of Expenses.

The expenses connected with building and maintaining the federation works are met by assessments levied on the Members of the Federation and the so-called Interested Parties. The first Apportionment of Expenses, as already mentioned, is made by the Supervisor as a basis for the representation of Members in the Federation Assembly. Subsequently it is made by the Executive Committee. The Statute states that the expenses shall be apportioned annually during the first five years, and after that, at least once in six years.

It mentions further, that the annual Budget shall include allowance for maintenance and operation of the federation works, interest charges and sinking fund payments on loans, and regular contributions to the Reconstruction and Reserve Fund which is provided to cover the cost of repairing federation works that have been damaged, by sinking of the ground, by floods, etc. The Reconstruction and Reserve Fund is gradually increased until it equals, at least, the amount of the annual Budget, averaged for the three preceding years. The Fund must be held in reliable securities, and when drawn upon, the amount used, as well as the purpose therefore, must be reported by the Executive Committee to the Federation Assembly at its next meeting.

The Statute stipulates that in drawing up the Budget, the cost of the works for the main river and for the tributaries shall be kept entirely separate, and that in apportioning the federation expenses, consideration shall be given, first to the *Responsibility*, of those assessed, for the existing objectionable conditions, and second, to the *Benefits* which will result to them, directly or indirectly through the construction, and operation of the federation works. If the free outlet for the water in any locality is interferred with by settling of the ground resulting from the operation of a coal mine, the owners of the mine must pay for the necessary alterations in the channel of the stream. And should a town persist in allowing septic sewage from cesspools to enter the sewers, it will have to pay a larger yearly assessment as its share of the expense of operating the sewage disposal works.

Industrial plants, other than the mines, are not assessed directly unless the amount they would have to pay is greater than $1,250 per year. In cases where the annual assessment would be less than this amount, it is made a part of the assessment of the municipality in which the plant is located. New industrial plants, or extensions of existing plants which would increase their assessment by more than one fourth, are provided for in amendments to the Apportionment of Expenses prepared every three months. At the end of the first five years the Federation Assembly may determine whether it will be desirable or feasible in the future, to regulate the assessments by a Statute. Such a Statute or regulations would require the approval of the Supervisor.

The annual assessments of the federation Members must be deposited at headquarters every three months. If not paid, the amount, without interest, is added to the next annual assess-

ment. The annual assessments of the Mines and other Interested Parties must be collected quarterly by the federation Members and turned over to the Federation. The Statute defines such assessments as ordinary public debts which may be collected by the regular process of law. The foregoing applies to temporary occupants, as well as to the owners, of industrial plants.

The Apportionment of Expenses, when drawn up by the Executive Committee, must be made public and sent to all those concerned in it. After it has been revised, on account of objections which may have been raised, it is published a second time and then submitted to the Supervisor for his approval, the approval being limited to the form of the document and its compliance with the law. Further protest against the Apportionment of Expenses may be made to the Protest Commission, but such protest does not excuse from payment of the assessment.

The annual operation and maintenance charges for the regulation of the main river, with interest figured at 4 to 4½ per cent., are about 7½ per cent. of the capital invested. For the sewage disposal works they have been found to be about 10 per cent. Approximately one per cent. of the total federation debt is paid off each year.

Protest Commission.

The Chairman of this Commission is a state official, usually a judge from the courts, who is appointed by the Supervisor and may not belong, through residence, land ownership, or business interests, to any of the municipalities in the Emscher drainage area. Another member of the Commission is an official from the State Bureau of Mines, appointed by the Bureau.

This is a very desirable arrangement, as the mines bear nearly 60 per cent. of the total expense of building and maintaining the federation works. Furthermore, the mines are often the largest taxpayers in a municipality, and thus contribute indirectly a large part of the municipality's assessment.

The Commission includes one of the Drainage Commissioners of the state department of unnavigable streams, likewise appointed by the Supervisor, and six of the Federation Representatives elected by the assembly for periods of six years. They may not be members of the Executive Committee. Two must be from the municipal delegations, and two professionally from the mining interests, and one professionally from the agricultural interests. At the same time, two must be from the Rhine Province and two from the Province of Westfalia. Any of the elected members of the Protest Commission may, for cause, be removed from office by the Supervisor, but with right of appeal to the proper Minister. Seven of the nine members of the Commission constitute a quorum. The meetings are public and are held at the federation headquarters or, when desirable, at any other place in the district. The members are reimbursed for travelling expenses and receive compensation, determined by the Executive Committee, for special work. In straightening out the protests, the Protest Commission has the power to make use of the federation employees. The expenses connected with this work are borne by the Federation but in special cases they may be assessed on the parties making the protests. There is no appeal from the final decisions of the Commission.

Work Accomplished.

A fundamental question in planning sewerage for the District was the kind of treatment to give the sewage. Ultimate discharge into the streams being unavoidable, it was evidently necessary, in view of the small stream-flow, to give the sewage *some* form of treatment.

After a careful study of the several processes of sewage treatment then in use, and much experimental work on a practical scale, it was decided to make provision for removing from the sewage as large a part of the suspended matters as possible, but *not* to go to the expense of providing works to oxidize the dissolved organic matter except in cases where the effluent was to be discharged into small, sluggish and poorly regulated streams. This decision was to some extent based on a belief that organic matter held in solution in sewage will not putrefy so long as the sewage is exposed to the air and flows rapidly in smooth channels. All of the Sewage Dis-

posal Works in the Emscher district, with one exception, consist of Settling Tanks of the Imhoff type and Sludge Drying Beds.

Because of the occasional gradual sinking of the ground which takes place in many parts of the district it was evident that both closed sewers and open channels would be insecure and would have to be especially protected. Furthermore, the settling of the land surface being unequal, the grades of the sewers were likely to be subject to frequent disturbance. If it is desired to permanently maintain good drainage in such a mining district, the sewer mains as well as the stream beds must be made capable of deepening, and this requirement is better met by open channels than by closed sewers. Open channels under the conditions in the Emscher district are also the cheapest to build.

It was therefore decided to use open channels for the main sewers leading to the sewage disposal works as well as for the smaller streams receiving the effluents of these works. The invert and side slopes of the channels are of smooth concrete blocks, which tend to prevent growths of vegetable organisms on the sides of the channels, and the grades adopted are sufficient to give a rapid current, the minimum allowable mean average velocity of the water being figured at 2.3 feet per second.

Good grades and smooth open channels which allow of the purifying action of sunlight and air have been found effective in keeping sewage fresh, and the character of the settled sewage gets better and better the further it goes. In some instances the raw sewage has a septic odor at the point where it enters the main sewer, due to the presence of cesspool cleanings, but this odor is much less noticeable when the sewage reaches the disposal works, perhaps a mile away. The open sewers are properly fenced on both sides, and there are inspectors who care for each section of the system and remove obstructions.

At various points along the line of the main river, as well as on the principal tributaries, sudden changes in grade, with a drop of 3 to 10 feet have been provided so that it will be possible to lower the beds of the streams at any point in the district whenever rendered necessary by subsidence of the ground.

After six years of active construction work there has been a material betterment of conditions all over the valley, and sewerage and suitable drainage facilities have been provided in most of the cities and towns. As a result of the continued rapid growth in population there is, however, much of this work still to be done and in some places it has not yet been possible to abolish all the cesspools or prevent their contents being occasionally discharged into the sewers.

The construction of main sewers and improved channels for the streams has done much towards reclaiming for building purposes or agriculture large tracts of land formerly under water, or so wet during much of the time that they were useless, unsightly and unhealthy.

There are already 20 sewage disposal works in operation in the district treating the sewage and manufacturing wastes of a population of approximately 700,000, and it is estimated that before December 31, 1913, 11 more works will be completed and treating the sewage of an additional population of 435,000.

The total estimated cost of regulating the main river is approximately $8,000,000, one quarter of which is for property rights. Seventy-five per cent. of this $8,000,000 has already been expended. At the present time the holdings of the Federation amount to 1,376 acres, nearly one-half of which is available for renting or selling, with an estimated value of $600,000. Three million dollars have been spent for the regulation of tributary streams and the construction of main sewers, and it is estimated that to complete this work there will be an additional expenditure of $8,000,000. The total length of main sewers already built and tributary streams that have been regulated is approximately 40 miles. The estimated cost of the sewage disposal works for the entire district is $1,750,000 which brings the total estimated expenditure for all the work eventually to be done by the Federation to $20,750,000, which is somewhat greater than the original estimate of $15,000,000.

During the year 1910–1911, the annual Budget was a little less than $500,000. When all

the federation works are finished it will probably be at least double this amount. The largest individual assessment which has thus far been made was about $40,000 per year and was borne by the city of Essen, having a population at that time of 280,000. Some of the largest mining companies in the District have been assessed as much as $20,000 each per year.

Taking the district as a whole, the municipalities bear about 28.5 per cent. of the total cost of the works, the mines 54.0 per cent., the steel plants 4.6 per cent., other industrial plants 0.7 per cent., private water works 8.0 per cent., the railroads 3.5 per cent. and other interested parties 0.7 per cent. respectively.

After all the federation works are completed the total annual assessment on the municipalities, to cover all operating, maintenance and interest charges, will average about $0.27 per capita which is approximately one tenth of the regular annual state tax. The corresponding annual assessment on the mines will be less than $0.01 per ton of coal, the price of which now averages $3.00 per ton.

Success of the General Scheme and Reasons Therefor.

The most instructive thing about the Emscher Federation lies in its powers and organization, as already described.

The Federation was made possible, in the first place, by the seriousness of the conditions in the District and by the Unity of interest in these conditions, among a large portion of the population. The success of the general scheme is due in large part to the fact that the Federation has absolute control over all the conditions affecting sewerage and drainage in the entire watershed of the river, and particularly to the fact that it is *not* a supervisory board with police powers, but actually raises the necessary funds and does all the work.

Six years experience in carrying out the provisions of the Statute have indicated the correctness of the principles on which it is based, as applied to the conditions in the Emscher district. The fact that both the Executive Committee which apportions the expenses and the Protest Commission which decides on the justice of the apportionment, are made up largely of Representatives of the Federation Members which pay the expenses, presents certain difficulties, but thus far this phase of the working of the Statute has not caused any serious trouble.

Through its corps of specially trained engineers, numbering more than 150 men, the Federation not only designs the main sewers, the disposal works and the regulated streams for all parts of the District, and carefully supervises their construction; but also takes charge of their operation and maintenance. The working of the various sewage disposal works is also watched by competent engineers and chemists, the degree of purification effected, as well as the condition of the water in the streams, being determined by regular analyses made in laboratories maintained especially for this purpose, and a well equipped experiment station is constantly in operation.

Finally, the experience gained from the design and operation of the portions of the federation works first constructed has made it possible to improve on the design of subsequent portions of the works with a corresponding increase in their general efficiency.

At the present time the chief engineer, or Baudirektor, so-called, of the Emscher Federation is Herr Baumeister Helbing. The chief of the sewer department of the Federation is Dr.-Ing. Karl Imhoff to whom the author is indebted for much of the information in the foregoing article.

APPROVED TECHNIQUE OF THE RIDEAL-WALKER TEST.

SAMUEL RIDEAL, AND J. T. AINSLIE WALKER,

The following details of the Rideal-Walker Test have been collated from the literature of the subject, published during the past ten years, and may be taken to represent the method as officially adopted at the present time in Great Britain and the British Colonies. In this, as in all other arbitrary tests, the need for strict observance of the conditions laid down by the authors cannot be too strongly emphasized. It has always been found when discrepancies in results obtained by the Rideal-Walker method were investigated, that one or more of the conditions called for in the test had been ignored. In the case of the Lancet Commission, for instance, the explanation was found to lie in the fact that the commissioners had been working with broth prepared from bullock's heart instead of Liebig broth, which had the effect of depressing all coefficients by about 50 per cent.

It is hoped, in presenting the following details of this test in a form which admits of easy reference, that the difficulties hitherto experienced by workers in this country in controlling the manufacture and sale of disinfectants may be met and overcome.

MATERIALS REQUIRED FOR TEST.

Nutrient Broth.

Liebig's Extract of Meat	20 grams
Peptone (Witte's)	20 "
Salt (Sodium Chloride, C. P.)	10 "
Distilled Water	1 litre

Boil the mixture for thirty minutes, then filter, and neutralize with normal sodium hydrate solution, using phenol-phthalein as indicator. In order to avoid contaminating the broth with phenol-phthalein it is advisable to take an aliquot part of the filtered broth—say 10 c. c.—and titrate this with decinormal sodium hydrate, calculating the amount of normal sodium hydrate necessary for the neutralization of the remainder of the broth. Add when quite neutral 15 c. c. of normal hydrochloric acid. This will give the broth a reaction of + 1.5 per cent. The broth is then made up to the litre, filtered and sterilized. Where two or three litres are prepared at one time, as is customary, the broth is distributed in 500 c. c. flasks on the following day and again sterilized. Five c. c. are then run with the aid of a small separating funnel into sterile test tubes,

which, after plugging with sterile cotton wool are placed in the steam sterilizer for half an hour or so.

Standard Carbolic Acid.

As carbolic acid crystals are very often contaminated by cresols to such an extent as to make them unreliable for purposes of bactericidal control, their purity should be established by a determination of the solidifying point (point of constant temperature) on at least 50 c. c. of the material with the thermometer in the liquid. The point is very sharp, the thermometer showing a constant temperature for a period of from five to ten minutes. The solidifying point of the crystals is 40.5 but anything over 40.0 may be accepted. A 5 per cent. (by weight) stock solution is then prepared and standardized by titration with decinormal bromine. From this solution (which keeps indefinitely in stoppered bottles) the various working strengths are made up by diluting some comparatively large quantity, such as 100 c. c., to the desired volume; this serves to eliminate the error introduced by measuring out small quantities of strong acid.

Dilutions of the Disinfectant.

A stock solution or emulsion should be prepared in 100 c. c. stoppered cylinder, with sterilized distilled water—10 per cent. if the coefficient be under 1, and 1 per cent. if over 1. Ten c. c. of this stock solution are used in preparing each of the 4 dilutions required for the test. Thus, working with a sample having a coefficient under 1, if it is desired to prepare a dilution of 1:70, 10 c. c. of the 10 per cent. stock solution are diluted with 60 c. c. of distilled water, and in the case of a preparation having a coefficient over 1, where the dilution required is 1:700, 10 c. c. of the 1 per cent. stock solution should be diluted with 60 c. c. of water. In preparing dilutions of the unknown, the limitations of the test must not be overlooked. The following is a safe rule for general work, expressing the dilutions as multiples of the carbolic acid dilution:—

With coefficients of 1 and under	x	0.1
With coefficients above 1 but not exceeding 10	x	0.5
With coefficients above 10 but not exceeding 20	x	1.0

For example, assuming that the strength of the carbolic acid control be 1:100, when it is desired to test a sample having a coefficient of 10, the dilutions to be recommended would be 1:950, 1:1000, 1:1050, 1:1100.

The Broth Culture.

B. typhosus, grown in R. W. broth and incubated for 24 hours at 37° C. provides the test culture. To insure even distribution of the bacilli in the broth culture, and to avoid the necessity of filtration, the culture tube should be shaken and allowed to rest for half an hour before it is finally

removed from the incubator, the temperature of which should not vary more than half a degree from day to day. It is advisable to make a sub-culture every 24 hours from the previous 24-hour culture, even if on many days no test is to be performed; but as this tends to attenuate the organism it should be continued for not more than one month, after which a fresh sub-culture in broth should be taken from a month-old agar culture. By this means a culture not varying much from day to day in resistance to disinfectants is obtained, making the selection of the proper dilution

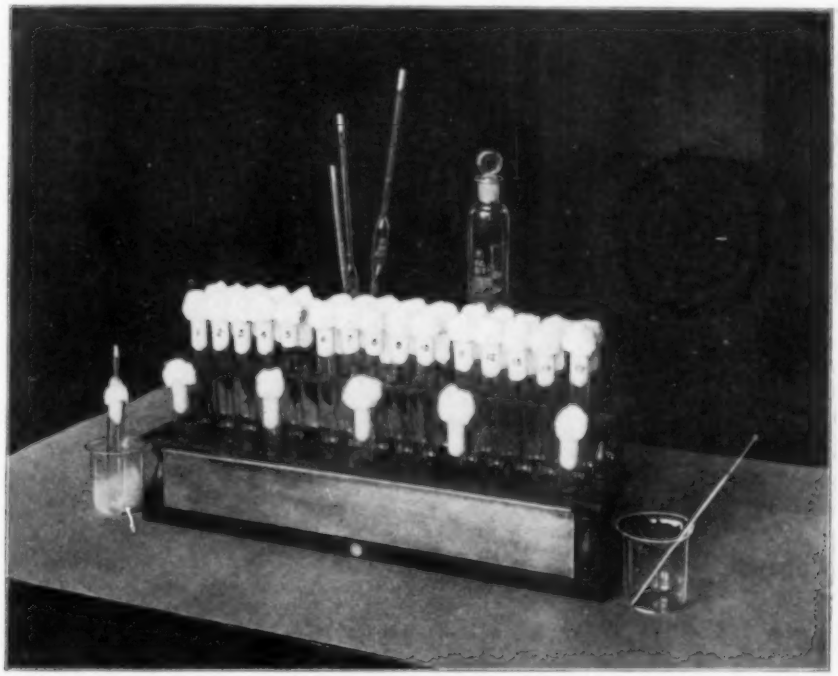

Fig. 1.

of carbolic acid much easier than it would be if the culture from which the 24-hour growth is obtained were older on one occasion than on another.

Apparatus Required for Test.

(The R-W apparatus as shown in Fig. 1 may be obtained from Arthur H. Thomas Company, of Philadelphia, Pa.)

Test Tube Rack.

A special rack is used. It contains two tiers, the upper having holes for 30 test tubes, in two rows, each row containing three sets of five; this tier is for the sterilized broth tubes, each of which is numbered with grease pencil. The lower tier is for the medication tubes—four with dis-

infectant dilutions and one with the carbolic acid control dilution, the latter being placed in the fifth hole. The lower tier is provided with a copper water bath to keep the temperature of medication within the prescribed limit—15° to 18° C. The test tubes being numbered in rotation it will be seen that the first medication tube is used for inoculating broth tubes, 1, 6, 11, 16, 21 and 26, the second for 2, 7, 12, 17, 22 and 27, etc.

Inoculating Needle.

The needle used should be composed of thin aluminium rod, with a short piece of platinum wire (26 U. S. gauge) passed through and twisted round an eye in the end of the rod, or otherwise firmly fixed thereto. The wire is made into a loop at the end and bent slightly in the center to allow of a fair sized drop being taken up for each inoculation. Satisfactory results cannot be expected when one tube is inoculated with a full drop and a mere film is introduced into another. The length of the wire to end of loop should be about $1\frac{3}{4}$ inches. After a little practice it is easy to obtain a satisfactory drop by dipping the needle in the medicated culture and bringing it out with a slight jerk. The loop used has an internal diameter of 3 m. m.

Test Tubes.

The test tubes should be of fairly strong glass so as to minimize as far as possible the risk of breakage, and lipped, to facilitate manipulation of plugs. Five inches by $\frac{5}{8}$ inch is the size recommended for use. The cotton wool plugs for both medication tubes and broth tubes should be well made, so that they can be withdrawn and replaced without loss of time. A convenient method is to place a thin flat piece of cotton wool over the mouth of the test tube, with a smaller piece in the center to form a core, and to push both into position with the aid of a thin glass rod.

Dropping Pipette.

This is used for the broth culture and is standardized to deliver 0.1 c. c. per drop. It is loosely plugged at the top with cotton wool, and when not in actual use is kept in a sterile test tube plugged at the mouth with cotton wool. For greater convenience the tube should be passed through the center of the plug and fastened thereto with wire.

In addition to the above, one or two each of the following are required: 1, 5 and 10 c. c. pipettes; 100 and 250 c. c. stoppered cylinders (with inverted breakers, to safeguard against dust after removal from sterilizer); wire baskets to receive tubes for incubation or sterilization. All pipettes and cylinders should be standardized.

Technique.

Before commencing the test it is necessary to ascertain the carbolic acid control dilution which will give the desired result — *i. e.*, life in $2\frac{1}{2}$

and 5 minutes. This is done by running a trial test with 5 dilutions of the carbolic acid only—say, 1:80, 1:90, 1:100, 1:110 and 1:120. Five c. c. of the control solution so ascertained are then pipetted into the fifth medication tube, the other 4 receiving 5 c. c. of the various dilutions of the disinfectant under test. To save time and apparatus, one pipette can be made to do service at this stage by starting with the phenol solution and following on with the highest or lowest dilution of the disinfectant, according as the coefficient is below or above one, rinsing out the pipette in each case with the next dilution before measuring off the sample for test.

The plug of the culture tube is now replaced by the culture pipette which, as explained above, has a plug attached to it with wire, at such a height

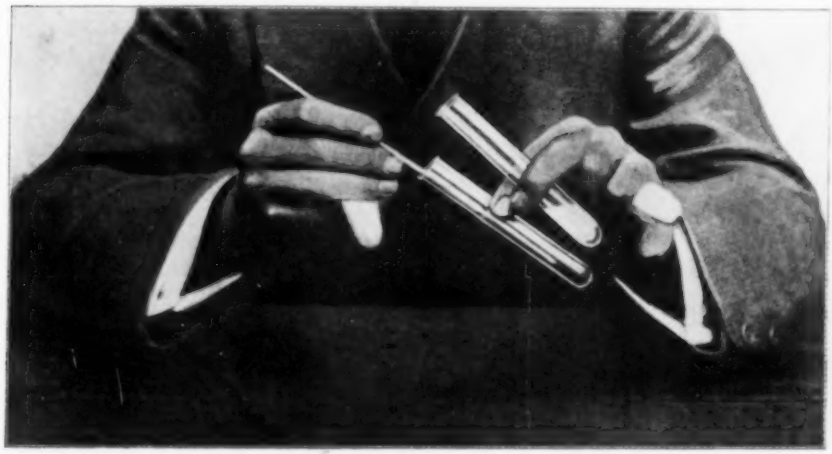

Fig. 2.

that when the plug fits easily into the mouth of the culture tube, the point of the pipette is half way down the broth, and clear of the clumps. The first of the five medication tubes is now inoculated with five drops of the culture—*i. e.*, 0.5 c. c. At intervals of half a minute each of the other medication tubes is inoculated in turn. By the time the fifth tube has been inoculated the organism in the first will have been exposed to the action of the disinfectant for two minutes, and after the next half minute a loopful of the latter is inoculated into the first broth tube, loopfuls from the other medication tubes being in turn inoculated into their respective broth tubes at the rate of one every thirty seconds. By the time the fifth broth tube has been inoculated from the fifth medication tube, the disinfectant in the first medication tube will have acted on the test organism for $4\frac{1}{2}$ minutes, and after the next thirty seconds a loopful is introduced

into broth tube 6, and so on. The actual test, therefore, occupies 17 minutes, and provides for six 2½-minute periods of contact in each of the five medication tubes.

It is open to the worker, of course, to adopt any convenient method of manipulating the tubes and plugs. The following procedure is given for the guidance of the inexperienced. (See Fig. 2). The first medication tube is taken from the rack and the contents gently agitated for a second to ensure even distribution of the bacilli; the plug having been taken out and grasped by the left little finger, the tube is held between the back of the left forefinger and front of the second. The corresponding broth tube (No. 1) is taken up by the right hand and transferred to the left between the thumb and forefinger, the plug being extracted and held by the little finger of the right hand. The tubes now being in position for inoculation, the needle, which should have been sterilized before the tubes were touched, is introduced into the medication tube, from which a loopful is taken and inoculated into the broth tube. The needle is sterilized in the flame, (placed to the right) and pushed with a movement of the thumb well up between the first and second fingers of the right hand; the plugs are then replaced, the medication tube going back to the rack while the broth tube is subjected to a gentle agitation and placed in a wire basket on the right of the rack. This basket containing the thirty inoculation tubes and test form giving particulars of the dilutions, etc., is now placed in the incubator where it is allowed to remain for 48 hours at blood heat, when the results are read off. A moment's consideration of the manner in which the test has been conducted will suffice to indicate where the results of each subculture should be placed in the table.

The following details of a test of pyxol show the form in which the results are set out; incidentally it shows the degree of refinement to which the test can be carried with a little practice and care. (See page 581.)

The strength or efficiency of the disinfectant under test is expressed in multiples of carbolic acid, and is obtained by dividing the dilution of the disinfectant showing life in 2½ and 5 minutes by the carbolic acid dilution, which, of course, must show the same result. In the present instance this 'figure of merit', or Rideal-Walker coefficient is 20.0.

To avoid annoyance and loss of time caused by aerial contamination of tubes, etc., it is advisable to conduct the test in a room free from draughts; a further safeguard is provided by spraying or swabbing the floors and benches with an efficient disinfectant solution. Needless to add, all pipettes etc., must be rigorously sterilized before use.

B. TYPHOSUS, 24 HOURS' BROTH CULTURE AT 37° C.

Temperature of Medication 15° to 18° C.

Sample.	Dilutions.	Time culture exposed to action of disinfectant—minutes.						Sub-Cultures.	
		2½	5	7½	10	12½	15	Period of Incub.	Temp.
Pyxol	1 : 1900	x	.....	.....	.....	.....	.....	48 hours	37° C
Pyxol	1 : 2000	x	x	.....	.....	.....	.....	"	"
Pyxol	1 : 2100	x	x	x	.....	.....	.....	"	"
Pyxol	1 : 2200	x	x	x	x	.....	.....	"	"
Carbolic Acid	1 : 100	x	x	.....	.....	.....	.....	"	"

∴ Rideal-Walker Coefficient $\frac{2000}{100} = 20.0$.

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STANDARDIZATION OF DISINFECTANTS:

Some Suggested Modifications.

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As sources of infection and modes of contagion become more generally known, so also the need for efficient disinfection is more generally appreciated. For many years carbolic acid or phenol proper was the first and almost the only substance thought of as a real germicide, other substances, as copperas and chloride of lime, being commonly recognized as deodorants only. Sophistication of these agents was probably not practiced to any considerable extent.

The advent of proprietary articles for disinfection opened the way for the exploitation of more or less valuable substances of a similar character to phenol but with claims of greatly increased germicidal value. The question naturally arose: Are they more or less valuable than carbolic acid in the recommended dilutions?

So insistent is this question that bacteriologists vie with each other in suggesting methods by which the value can be determined. From the Garnet Method of Krönig and Paul to the latest one to be proposed, that described in *Bulletin 82* of the Hygienic Laboratory is a long step. This development, however, has been a process of evolution. The methods now employed are modifications of the fundamental principle first published by Rideal and Walker (*Journ. Royal San. Inst.*, 1906) that the value of a disinfectant can best be determined in the laboratory by exposing filtered bacteria suspended in culture medium to the action of the diluted disinfectant, the maximum efficient dilutions of sample and of pure phenol being compared to determine the coefficient of the sample, a value which is necessarily relative.

Suggestions have been made by various workers to modify the details in the process. Blythe and others (*Journ. Soc. Chem. Ind.*, 1906) suggested the addition of organic matter; Chick (*Journ. of Hyg.*, 1908) that the velocity of the reaction between organism and disinfectant be used as a determining factor; the Lancet Commission (*London Lancet*, 1909), the use of B. *coli communis* in bile salts medium as the organism; Anderson and McClintic (*Bulletin 82*, Hygienic Laboratory) without suggesting any radical change, reviewed the published methods and adopted from them, those details which, when slightly modified, seemed to them to meet the requirements for a simple and accurate method. This is a logical course to pursue and since the Hygienic Laboratory Method, as its authors prefer

to call it, has been recommended by the Committee of the American Public Health Association for adoption and has in fact been adopted by some of the State Boards of Health, it seems advisable to suggest at once any changes which will simplify, shorten or improve the process of standardizing disinfectants.

The authors of this paper contributed to the literature on the subject (*Am. Journ. of Public Health*, 1912), a description of the method in use for ten years in the laboratory of Parke, Davis & Co. for standardizing disinfectants. Since the publication of the Hygienic Laboratory Method, both methods have been used as a means of becoming familiar with the details of the latter and of comparing the results obtained by each.

In the course of this work, various modifications have suggested themselves, some of which seem of sufficient value to be published.

Organism. Without any question it is essential that the same strain of the same organism must be used in order to insure uniformity in results. The coefficient obtained with one strain of *B. typhosus* may be 50 per cent. to 100 per cent. higher than that obtained by using another. Even the same strain,—*B. typhosus* (Hopkins), obtained from the Hygienic Laboratory—changed in its relative resistance toward phenol and other coal tar disinfectants to such an extent that coefficients obtained with it as the test organism were 50 per cent. higher than with a fresh culture.

Without special precautions and even in spite of such precautions a culture may change imperceptibly until the results with it are not comparable with the values previously obtained.

Whether the facts above noted are peculiar to the Hopkins culture or to its being grown in the culture medium adopted by the Committee for the Bacteriological Standardization of Disinfectants, this being the one used by Anderson and McClintic, has not yet been determined. A later publication will take up this phase of the problem.

Temperature. Experiments have been conducted which prove that more uniform results may be obtained from day to day by working at a constant temperature. Within reasonable temperature limits the coefficient at different temperatures remains fairly constant because of testing the standard under the same condition. But since the temperature factor is considered of importance by most writers this feature may be adopted, the advantage to be gained, however, is not in accuracy but in uniformity in daily results.

Seeding Tubes. The use of wide seeding tubes recommended by the Lancet Commission and incorporated in the Hygienic Laboratory Method gives greater opportunity for accidental contamination. This, however, may not be serious since if not too frequent the illogical results occasioned by this factor are easily detected and can be ignored in drawing conclusions.

Temperature Adjustment. When the wide tubes are used and the tem-

perature is to be adjusted as first recommended by Rideal and Walker a convenient way to carry it out is to have a sheet iron pan three inches deep and of such dimensions that the perforated block suggested in *Bulletin 82*, Hygienic Laboratory, will exactly cover it and rest on its edges (see Fig. 1). Such a pan will hold sufficient water to keep an even temperature for an hour—the time required to test 60 dilutions for a period of 15 minutes each. The block must be modified by being made only seven eighths of an inch thick and have the holes bored through. When placed on any flat surface, the seeding tubes will stand upright in a convenient position for filling. After filling the measured disinfectant solution into the tubes, the board can be placed over the pan for the succeeding steps of seeding and

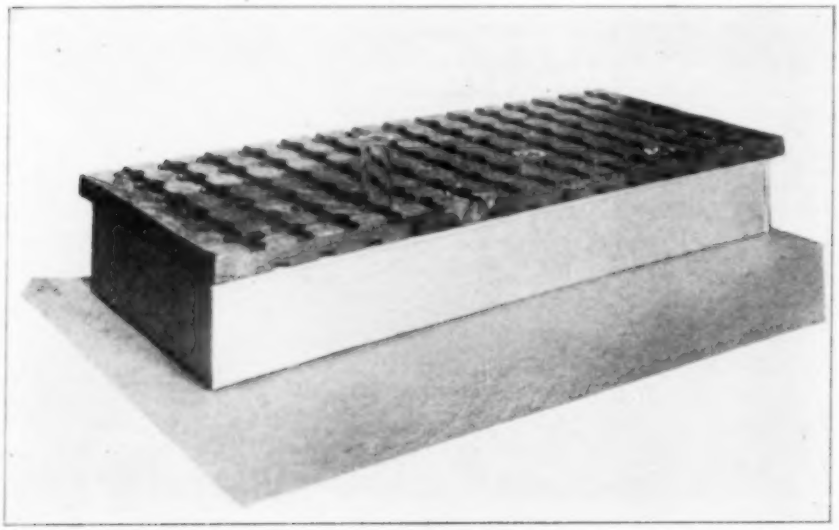


Fig. 1.

subculturing. The tubes will pass through the holes to a depth of two inches below the bottom of the board till held by the flange.

Sterilizing Loops. Two simple adaptions of the Lancet Method for sterilizing the platinum loops have been used. One of these (see Fig. 2), consists of a firmly supported slab of asbestos placed in a slightly inclined position. At the higher edge of this slab a disk of sheet iron bent at right angles along its diameter is fastened in such a way that the handle of the loop will lie in the bend in a horizontal position at such a height as to be in the flame of a fish tail burner. A spring under one side will raise that side slightly above the horizontal to keep the loop over the flame. A slight pressure will depress the disk enough to roll the loop off after which the disk returns to the position for holding the next loop. The sterilized loop

rolls down the slightly inclined slab to an obstruction or to the loop previously sterilized. A cut-out in the asbestos slab under the handles of the loops makes it easier to pick them up. This simple apparatus has several points in its favor: 1st, it requires only one small flame for sterilizing; 2d, the wire is never heated more than 15 seconds; 3d, the coolest wire is always nearest to the operator; 4th, only one hand is needed to operate it,

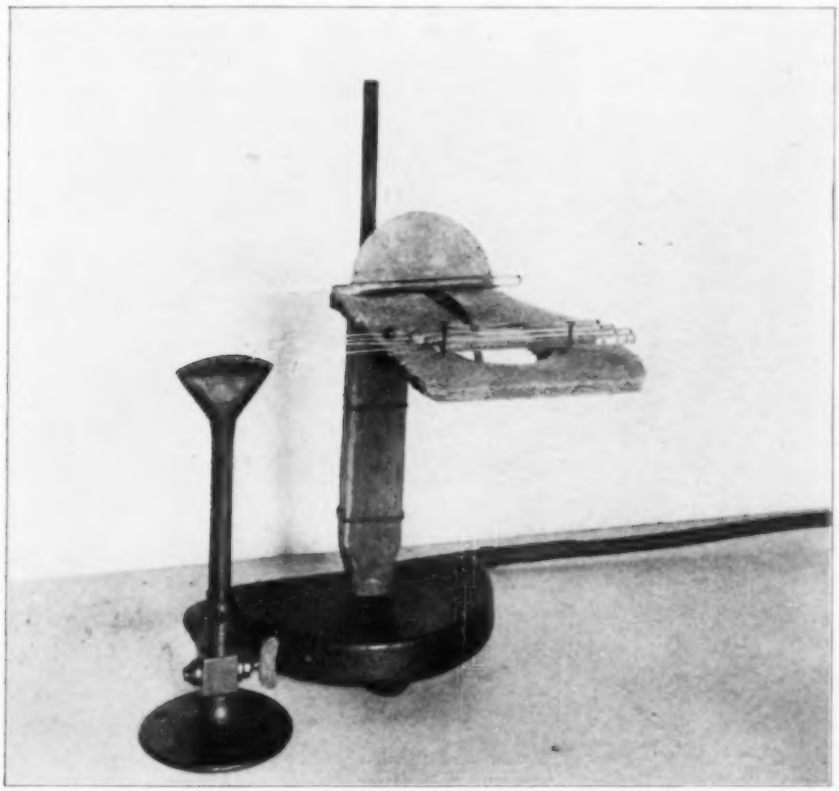


Fig. 2.

since the flame is stationary; 5th, the whole apparatus can be devised from apparatus and material at hand in any laboratory.

The other method illustrated (see Fig. 3) makes use of a revolving holder for the platinum loops. The axis of this holder is the Bunsen burner tube. The handles of the loops are held upright in a slot in which they can be tilted so the loop is either in or out of the flame. Very few movements are necessary to operate this method and it has several advantages over others. One of these is that there is nothing to get out of order, another, that a

blue flame is used, thus avoiding the formation of carbon on the wires. This occurs occasionally with a fish tail burner and is very destructive to the wires.

Abridged Methods. When many dilutions are to be tested, especially when one knows approximately what dilutions of the disinfectant will not give growth at 2½ minutes and those that will allow growth after 15 minutes, it is possible to shorten the time of testing and to use fewer tubes of culture medium by discarding the strong dilutions after one or more sub-

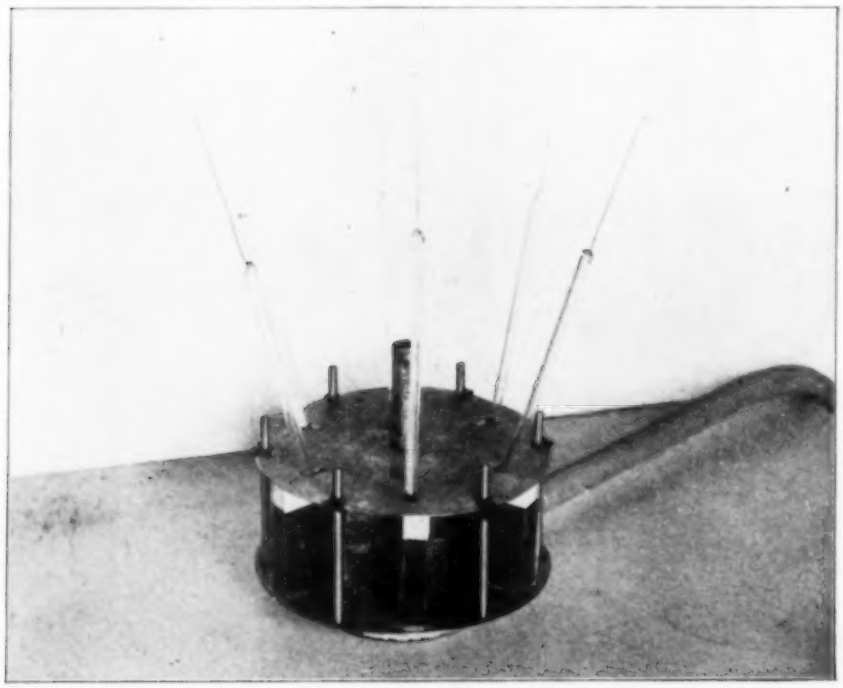


Fig. 3.

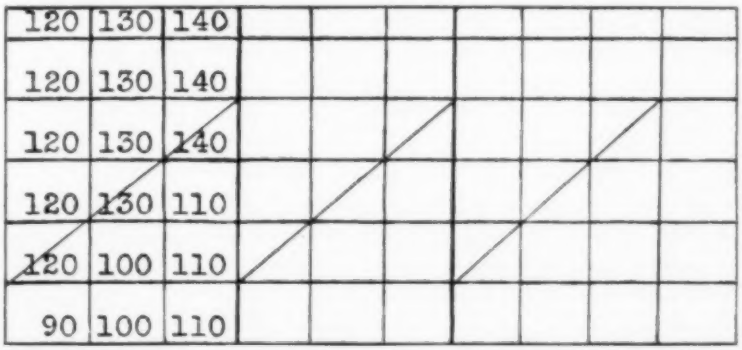
culture have been taken out, and substitute the weaker dilutions which would certainly have given growth if subcultures had been planted after only short exposures.

First. A scheme was outlined to set two rows of ten seeding tubes, each with dilutions of the disinfectants to be tested. If dilutions of phenol and two disinfectants are to be tested, the twenty seeding tubes containing them may be arranged in the board as follows:

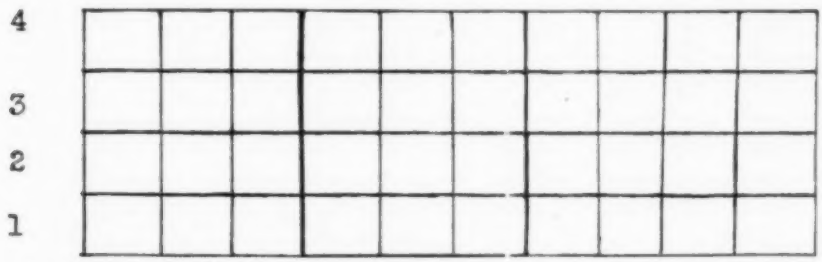
Phenol			A			B			
120	130	140	500	550	600	1600	1700	1800	1900
90	100	110	350	400	450	1200	1300	1400	1500
1	2	3	4	5	6	7	8	9	10

The "90 dilution" is seeded first and during the 15 seconds allowed for that step, the "120 dilution" is also seeded; then the 100 and the 130 dilutions during the second 15-second period. An assistant is needed to shake the tubes before returning them to their proper locations. When all have been seeded in the 2½ minute period, then a subculture is taken from each tube in the lower row. After this, tube 120 is substituted for 90, 500 for 350, and 1600 for 1200. After the 5-minute subcultures have been planted, 130 is substituted for 100, 550 for 400 and 1700 for 1300. After the 7½-minute subcultures have been planted, then 140 is substituted for 110, 600 for 450 and 1800 for 1400. After the 10-minute subcultures have been planted 1900 is substituted for 1500 and no further changes are necessary.

The results can best be recorded by using a diagram representing the rack containing the subcultures, the diagonal line passing through the first subculture of the higher dilution.



Second. This was later further shortened by making subcultures only at 2½-minutes and 15 minutes, according to the following scheme.



4 and 3: 2½ minutes. 2 and 1: 15 minutes.

In the rows 1 and 2 are placed the seeding tubes containing such dilutions of the disinfectants as should show both growth and no growth in 15 minutes. In rows 3 and 4, such dilutions as should show both growth and no

growth in 2½ minutes. The rows are seeded in order, 1, then 2, then 3, after which subcultures are taken from 3. Then 4 is seeded and immediately subcultured. Then the first and second rows are subcultured successively.

By this scheme only 20 minutes are required to seed and subculture 40 dilutions and only 40 tubes of medium are needed.

All the data necessary for the coefficient is obtained by this method since the coefficient is based entirely on the greatest dilutions which kill the bacteria in 2½ and 15 minutes. One can choose either a great range in dilutions or have check dilutions, since no time is gained by having fewer than 40 dilutions.

The only objection to be advanced against these abridged methods is that without the results between the 2½ and the 15-minute subcultures, wrong conclusions may be drawn. These, however, are corrected by check tests.

The foregoing points are offered, not as criticisms on any method, but suggestions applicable to methods commonly used. They may be helpful to others as they have been to us in simplifying and shortening an irksome process.—*From the Research Laboratory of Parke, Davis & Co., Detroit, Mich.*

THE BACILLUS OF WHOOPING COUGH AND THE LESION IT PRODUCES.

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Read before the Massachusetts Association of Boards of Health, Boston, Mass, April 24, 1913.

Last summer, while going over the autopsy from a case of whooping cough microscopically with one of the internes, I made the observation that between the cilia lining the trachea there seemed to be innumerable minute organisms present. That was the starting point of the investigations which I have the pleasure of reporting to you today. I will speak very briefly of the first historical side of whooping cough from the pathological point of view and then demonstrate what we have found.

In 1890 Bordet and Gengou discovered an organism in all of the acute cases of whooping cough which they examined, but it was not until 1896 that they were able to obtain the organism in pure culture. They were also able by using an emulsion of the organism and serum from the patient's blood to get a complement fixation test. That fact showed pretty conclusively that the patient produced an antibody for the organism, and that has been the basis of the proof since that the organism causes the disease. But although the bacillus is generally accepted by the bacteriologists as the cause of whooping cough, it has not been accepted to any extent by the medical profession, because no lesion was ever demonstrated in connection with the organism, only the organism in connection with the disease.

In 1908 Klimenko repeated the work which Bordet and Gengou had done, confirmed their results, and made certain experiments with pure cultures on animals. He inoculated about thirty puppies and a few monkeys and studied their symptoms. The puppies nearly all died in the course of a few weeks. They developed coughing and sneezing but never whooped. After the animals died or were killed he was able to obtain the pertussis bacillus again from them in pure culture.

The organism is exceedingly minute and looks a good deal like the influenza bacillus, but it does not require hemoglobin in order to grow. On the other hand the only medium on which it is possible to start it multiplying is a potato-blood-agar mixture devised by Bordet. The bacillus grows very slowly at first and forms minute transparent colonies which in time enlarge and acquire a slight brownish color, but not very much.

After a certain amount of artificial cultivation it can be grown to some extent on other media.

The bacillus is Gram-negative, non-motile and varies in shape from round to oval.

Figure 1 shows the lesion we found in the trachea of a child who died from whooping cough at the end of two weeks. Masses of minute bacilli are packed in between the cilia of the epithelial cells. They number dozens to a hundred or more over each cell. Figure 2 shows them more highly magnified so that the separate organisms can be made out distinctly.

The bacilli seem to act mechanically only. They interfere with the action of the cilia and thus furnish a continuous irritation which excites coughing of a spasmodic type. Finally the coughing, which is not able to remove the organisms, is followed by a violent intake of air, the whoop.

Figure 3 is from the trachea of a patient who survived six weeks. A few bacilli are still present between the cilia but most of them have disappeared.

Examination of some lung tissue preserved from a case of whooping cough which came to autopsy fifteen years ago showed masses of similar organisms in the same characteristic position between the cilia of the epithelial cells lining the bronchi.

It has been possible to study lung tissue from two other cases of whooping cough and in both of them the same lesion was found. The organisms occur only between the cilia and occasionally free in the secretion. They were never found within the air sacs. In two of the cases studied, bronchopneumonia was present, but it was due to a secondary invader, the pneumococcus, not to the whooping cough bacillus.

While the action of the organism is chiefly mechanical it evidently secretes a certain amount of toxin. This is shown in three ways. There is a slight inflammatory reaction. Leucocytes in small numbers migrate through the wall of the trachea. The blood of whooping cough patients always shows a certain degree of lymphocytosis. Finally the blood serum develops an antibody which renders it possible to obtain a complement fixation test.

The finding of these lesions in human beings naturally suggested experimental work on animals. We first inoculated sputum obtained from acute cases of whooping cough into the trachea of a puppy and also into that of a rabbit. In both instances we obtained a lesion corresponding in every way to that found in human beings as these two lantern slides clearly demonstrate.

We next set about obtaining pure cultures and after considerable effort succeeded in doing so. We found that the easiest way to inoculate an animal with the organism was to make a suspension in bouillon and then pour it gently a drop at a time into the animal's nostrils. In this way it was compelled to inhale more or less of the culture.

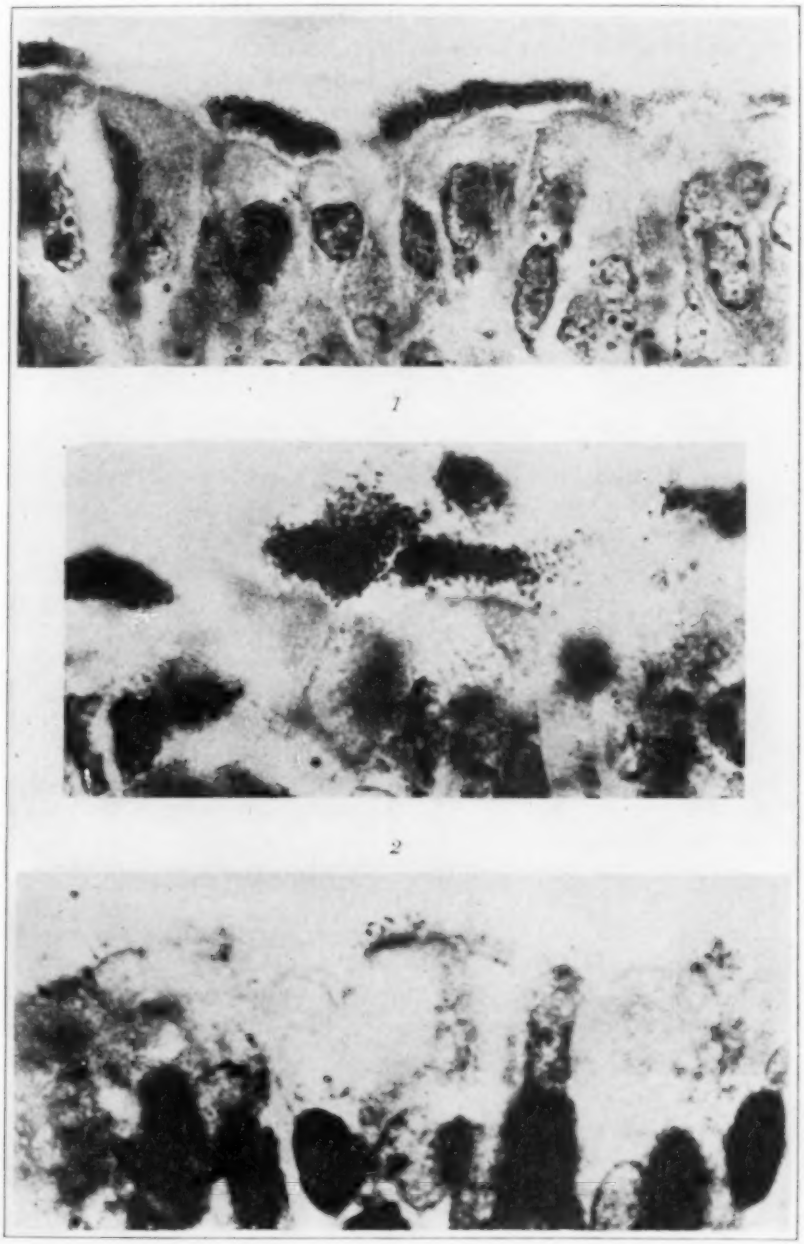

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Fig. 1.—Ciliated epithelium lining trachea of child dying in acute stage of whooping cough. Masses of minute bacilli present between cilia. x 1,000.

Fig. 2.—Ciliated epithelium lining trachea from same case. x 1,500.

Fig. 3.—Ciliated epithelium lining trachea from child dying at a late stage of whooping cough. Bacilli still present in small numbers between the cilia. x 1,500.

We were able in this way to duplicate in puppies and rabbits the lesions which we had found in the human cases. Finally we used for inoculation purposes a strain of organism which came originally from Bordet and with it obtained the same result.

The work on human beings has been controlled by the study of dozens, I might say of hundreds, of cases. There is no question about the organism occurring in whooping cough and not in any other disease, and of its relation to the lesion. Up to three days ago it seemed as though the work on animals was equally sure, but on that date Dr. L. J. Rhea, who was interested in the distemper in dogs, examined the trachea from a dog which died of that disease and made the interesting but unfortunate discovery that a similar organism is present between the cilia of the cells lining the trachea and bronchi. In other words, we have in these animals, that is in the dog, and in rabbits, guinea pigs and cats, a lesion produced by an organism closely resembling that which causes whooping cough in man. His observation necessarily throws a certain amount of doubt on our experimental work and also in Klimenko's because, although we started with the whooping cough bacillus and got it back, as we believed, in pure culture again, the lesion which we have been examining may have been produced by this other organism. There is no way of telling them apart histologically in sections. It means that this part of the work, the experimental part, will have to be done over again. We must control our work more carefully, being sure, in the first place, if we possibly can be, that the animals are not infected with the bacillus bronchisepticus, as it is called, and getting back beyond question the bacillus of pertussis. The two organisms look much alike, when grown on Bordet's medium, but they can be distinguished by the use of special media, especially of litmus milk, because the bronchisepticus produces a great deal of alkali and turns the milk intensely blue. It is also motile and the whooping cough bacillus is not.

It is unfortunate but that is the present state of the question. The work has at least called attention, however, to a peculiar lesion which occurs not only in whooping cough but in the distemper of animals. The two organisms will have to be investigated more thoroughly and their relation to each other ascertained.

MASSACHUSETTS ASSOCIATION OF BOARDS OF HEALTH.

The quarterly meeting of the Massachusetts Association of Boards of Health was held at the Brunswick Hotel, Boston, Thursday, April 24, 1913, under the presidency of Dr. Samuel H. Durgin.

Report of Legislative Committee.

Up to this time but little legislation of interest to local boards of health has been enacted by the present Legislature. In this class there are but three new laws, which are:

Chapter 210. An Act providing that local boards of health make weekly reports on certain diseases to the state board of health.

Chapter 265. An Act providing for the exclusion of certain deleterious substances from confectionery.

Chapter 278. An Act authorizing counties to provide facilities for bacteriological diagnosis.

The several bills calling for reorganization of the state board of health have not been reported upon by the Public Health Committee though the hearings on them were closed March 7.

The bill seeking to provide for appeals from decisions of local boards of health was given leave to withdraw; this was also the case with the bill which sought to change the determination of settlements from the overseers of the poor to local boards of health.

As regards milk legislation, the Ellis Bill, House 393, was reported unfavorably by the Joint Committee on Agriculture and Public Health, which report was yesterday accepted in the House of Representatives by a vote of 130 to 87.

The bill introduced by the Legislative Committee of this Association providing a state standard for clean milk was given a favorable report by unanimous vote of the joint committee and is now at the third reading stage in the Senate.

This bill is now Senate 492 and in view of the probable failure of other milk measures at the present session your committee urges the members of this Association to assist in the passage of this particular bill.

George E. Bolling,
Chairman.

On motion, the report was accepted and placed on file.

New Members.

The following gentlemen were elected to membership in the Association: John E. Drury, Lowell Board of Health; Carl Beede, Wellesley Board of Health; Robert N. Hoyt, agent, Wellesley Board of Health; Dr. John W. Pratt, Dedham Board of Health; Dr. Arthur Worthington, Dedham Board of Health; Dr. Joseph Francis Golden, Stoughton Board of Health; Frank W. Jackson, Brockton Board of Health; Dr. J. H. Burkhead, Middleboro Board of Health.

Papers Presented.

The following papers were then read:

"The Bacillus of Whooping Cough and the Lesion it Produces" by F. B. Mallory, M. D., Boston, Mass. (Printed in this issue of the *Journal*.)

"Whooping Cough, A Plea for More Efficient Public Regulations Relative to the Control of this Most Serious and Fatal Disease," by John Lovett Morse, M.D., Boston, Mass. (Printed in the *Journal of the American Medical Association, May 31, 1913, p. 1677.*)

Report of the Committee on Uniform Health Reports.

The report of the Committee on Uniform Health Reports was then presented by Dr. C. V. Chapin, the chairman of the committee. It was moved that the report be received and that 500 copies be printed at the expense of the Association and put into the hands of the treasurer for distribution to every board of health in the Commonwealth of Massachusetts. The motion was seconded and carried.

The report of this committee appears in full elsewhere in this issue.

Membership Committee.

It was moved that Professor Sedgwick, Mr. Coffey and Professor Rosenau be appointed a committee to circularize the boards of health in the state of Massachusetts to secure membership for this Association.

The motion was seconded and carried.

There being no further business, the meeting then adjourned.

REPORT OF COMMITTEE OF THE MASSACHUSETTS ASSOCIATION OF BOARDS OF HEALTH ON UNIFORM HEALTH REPORTS.

Presented to the Massachusetts Association of Boards of Health, April 24, 1913

The Committee on Uniform Health Reports was appointed at the suggestion of Prof. Selskar M. Gunn who presented to this Association at the January meeting, 1911, a paper on "Modern Board of Health Methods in Small Cities." In the preparation of the paper the writer had occasion to study the reports of fifty-six of the smaller cities of the United States, and found it impossible to obtain from them the data he desired.

It may perhaps seem to the Association that this committee has been dilatory in preparing the report, but it was found that the subject was one which required very careful consideration. Many long sessions were held and various points involved were discussed with local health officers in Massachusetts, some of whom have taken the trouble to be present at the meetings. The committee has also carried on a considerable correspondence with federal officials and with other persons interested in the subject.

Every one who has ever attempted to study any phase of public health work in the reports of the local health officers has had a most discouraging experience. The reports seem usually to be prepared without plan. Not only do they differ from one another in different cities but are for the same city, for different years, greatly unlike. While the majority of them are for the calendar year many are not, and even if they contain good tables of vital statistics, they are of no value for comparative purposes. Most reports are very unsatisfactory as regards their statistical tables as is well illustrated by the fact that twenty-four of

(This report is printed so that the size of the type page is that recommended for Health Department Reports).

the fifty-six reports above referred to, failed to give the population, and most of them arranged the causes of death alphabetically instead of according to the International Classification which has now been official in this country for over a decade. Not long since a member of this committee wished to learn the number of cases of scarlet fever and diphtheria for the last ten years in the principal cities of the country. It might be thought that an exact statement of the prevalence of these diseases would certainly be found in every health report, but the desired data could be obtained from less than half the reports of our most important cities. It is rare indeed to find a financial statement which is satisfactory or even intelligible, and a comparative study of expenses, based on health reports, is entirely out of the question. It has been argued that the local health official is not called upon to give information for the use of other cities, but we are all constantly learning from one another, and efficiency requires that every health officer, and every municipality, should furnish to others a clear account of what is being done to protect the public health. And in any event the same plan of report, the same material, and the same care in preparation, are necessary for the enlightenment of the citizens in one's own city, as for the information of health officers in other municipalities. Every citizen is entitled to know just what his health officials are doing, how much each phase of public health work costs, and the prevalence of different diseases, and he should be able to compare the data with those for preceding years. It was to facilitate the preparation of useful reports, and to suggest a certain necessary degree of uniformity, that this committee was appointed, and we accordingly present the following plan, or sketch, of a report, of which the accompanying tables are perhaps the most essential feature. Although the committee was appointed by the Massachusetts Association of Boards of Health, it has believed that it ought not to confine its attention to local conditions and needs and has therefore sought the assistance of the United States Public Health Service and of the Census Bureau and of a

number of persons in different parts of the country who are actively interested in the promotion of public health.

While a certain degree of uniformity in health reports is desirable, the committee wishes strongly to emphasize the danger of too great uniformity. At the present time many of the most active leaders and promoters in the field of public hygiene, have, as one of their chief aims, the promotion of uniformity in public health work. While more uniformity is desirable in some directions, there is great danger that the tremendous authority which universal custom gives to any procedure will stifle all initiative and experiment, and will so crystallize the practice of the time that the art of sanitation will fail to respond to the teachings of sanitary science. If greater uniformity in reports should encourage the health officer in complacently following the routine practice of other communities, it would be better to allow the present confusion of our reports to continue. Even the particular forms recommended by the committee are not intended to be absolutely binding or perpetual. Individual officers should, it is true, waive merely minor personal preferences or local custom, in order to align their reports with others, but if, after careful consideration, an officer devises what he believes a more efficient presentation, it will be in the line of progress to make use of it. While changes in the scheme of formal reports are always to be deprecated, additions are ever welcome. Progressive officials will continue to strike out on new lines of work and the result should always be presented with care and fullness in their reports.

The accompanying scheme for a report has been worked out primarily for cities of moderate size. To officials in small communities it may at first sight seem too elaborate for their use, but it is so only in appearance. Such officials will simply report on the work which is performed in their own communities, and omit whatever does not apply to their department. Many cities on the other hand may perform functions not referred to in the committee's scheme,

and the health reports of such would be expanded accordingly.

The committee most urgently requests all health officers, and particularly those of the smaller communities, not to be alarmed at the size of this report, or at the apparently elaborate scheme presented. It would have been folly to present a scheme which would not include the great bulk of public health work. It is believed that the scheme can be as easily followed in a health report of eight pages as in one of eighty pages.

Let no health officer, of even the smallest town, cast aside this scheme until he has compared his last report with it and noted how little additional work would be required, and what small additions would be necessary, in order to bring his report into alignment with it.

Where there is a health officer giving only a part of his time to the work, and no other employees, the report would consist of a short financial statement giving the appropriation and the expenditures, which, besides the health officer's salary, should specify the few additional expenses according to their purpose as indicated in the schedule. Then should follow a brief account of the health officer's work in the order shown. A few figures as to inspections, visits, etc., might be inserted in appropriate places. In connection with contagious diseases there should certainly be given a table of cases and deaths for ten years. Lastly there should be given the vital statistics. In a small place, where the births, deaths and marriages are few, it is not much work to prepare these tables.

If the health officer gives all his time to the work, or if a school inspector, or bacteriologist, or milk inspector, is employed, one after another of the headings in the scheme will be found to be useful and will be successively added to his report and the appropriate tables will be included. Thus the size and complexity of the report will grow with the amount and complexity of the work.

With this introduction the committee submit the following report which consists of:

I. A form for a report suitable for a well organized health department such as should be found in cities of 30,000 inhabitants and over and sometimes is found in smaller places.

II. A form for reports for smaller places.

III. Notes explaining in some detail what is demanded by various items in the scheme and giving some of the reasons for the recommendations.

IV. Model tables.

CHARLES V. CHAPIN, M. D., *Chairman.*
FRANCIS GEO. CURTIS, M. D.
WILLIAM H. DAVIS, M. D.
SELSKAR M. GUNN.
WILLIAM C. HANSON, M. D.

SUGGESTIONS FOR UNIFORM HEALTH REPORTS.

1. Main titles are essential and should be included in all reports. Subtitles are suggestions for subdivisions of main titles and may be still further amplified if desired. The main titles should be used in the body of the report as headings for the corresponding subjects.

2. The different subjects considered in the report should have the same relative position each year.

3. When a title covers work which locally comes under the jurisdiction of another department, the fact should be noted under that title, and if possible, some information should be given.

4. When a title covers a subject in which no work has been done during the year, the fact should be noted.

5. If the report covers more than fifty pages, an index, or at least a table of contents, should be included.

6. The size of the report should be 9 x 6 inches, unless a local ordinance prescribes a different size. This will allow about $6\frac{1}{2}$x$3\frac{3}{4}$ inches for the printed page. Do not use a

folded insert if it can be avoided. Tables should be vertical if possible.

7. The report should be mailed flat, not rolled or folded.

Amplified Form for Cities of 30,000 or Over.

A. Title Page.

B. Names and Addresses of Members of the Board.
   Executive Officer.
   Heads of Divisions.

C. Financial Statement.
   Table I.

D. Diseases Dangerous to the Public Health.*
   1. Methods for protection of community.
   2. Brief comments on prevalence of each disease during the year, including accounts of outbreaks.
      Table II.
      Table III.
   3. Bacteriological Laboratory.
      Examinations for diphtheria: diagnosis and release.
      Examinations for typhoid fever, tuberculosis, malaria, etc.—Special Work.
   4. Isolation Hospital.
      Number of cases of each disease treated—results.
      Percentage removed to Hospital.
      Return cases.
      Per capita cost.
      Average length of stay in hospital for each disease.
      (Living cases and deaths tabulated separately.)
      Table IV.
   5. Care of cases outside of Hospital.
   6. Control of Tuberculosis.
   7. Distribution of Antitoxin.
      Administration of Antitoxin—results.

* In Massachusetts this term is prescribed by statute, and includes all those diseases notice of which must be sent to the local and state Boards of Health. (See List published by State Board of Health).

8. Vaccination.
9. Disinfection.
   Methods.
   Cost.
10. Maritime Quarantine.

E. Infant Mortality.
   Milk stations.
   Nurses, etc.

Table V.

F. School Inspection.
   (State whether school or calendar year is covered.)
   Details of work.
      School physician's report.

Table VI.

      School nurse's report.

Table VII.

G. Food Inspection.
1. Dairy inspection.
   Dairy inspector's reports.
2. Milk inspection.
   Milk inspector's report.
   Laboratory work.
   Samples examined { chemically. / bacteriologically.

Table VIII.
Table IX.
Table X.

3. Ice cream.
4. Vinegar inspection.*
   Inspector's report.
5. Bakeries.
6. Drug inspection.
7. Meat and provision inspection.
   Inspector's report.
8. Inspection of slaughterhouse and of animals at the time of slaughtering.
   Inspector's report.

* Required by the Massachusetts statutes.

H. Nuisances.

Any special work which needs to be noted.

I. Municipal Wastes.

House offal and garbage.

(Define term. Give figures in tons or cubic yards, not loads.)

Method of collection.

By municipality—by contract—by individuals—how often.

Method of disposal.

By burning—by burying—by feeding to swine—by sale—by dumping at sea, etc.

Cost of work.

(Make distinction between cost of collection and disposal, when possible.)

Ashes and combustible waste.

(If separated, note fact.)

Table XI.

J. Inspection of Plumbing.

K. Research, Educational and Publicity Work.

L. Other Work done During the Year.

(This title should cover all work done by the Board of Health not included in other titles, and each subject should be treated separately.)

M. Rules Passed Since Last Report.

N. Local Problems.

O. Recommendations.

P. Vital Statistics.

Tables XII to XVI.

Simplified Form.

A. Title Page.

B. Names of Members of Board.

(In small towns where Selectmen act as Board, give name of Agent or Executive Officer, with office hours, if necessary.)

C. Financial Statement.

Table I.

D. Diseases Dangerous to the Public Health.*
Give short account of the occurrence during the year.
Table II.
Table III.
E. Infant Mortality.
Table V.
F. School Inspection.
Table VI.
Table VII.
G. Food Inspection.
Special reference to milk and dairy inspection.
Table VIII.
Tables IX. and X.
H. Nuisances.
I. Municipal Wastes.
Garbage.
Ashes.
J. Inspection of Plumbing.
L. Other Work Done During the Year.
M. Rules Passed Since Last Report.
P. Vital Statistics.
Table XII.
Table XIII.
(State whether population is census or estimated: if estimated follow directions on page 614.

NOTES ON SCHEME FOR REPORTS.

A. Always indicate clearly whether the calendar year or some other year is covered by the report. It is very desirable that all reports be made to cover the calendar year. This is the custom in most cities and those which do not conform to it can usually easily arrange to do so. It is more

* In Massachusetts this term is required by Statute and includes all diseases, notices of which must be sent to local Board of Health. (See List published by State Board of Health.)

difficult to make the financial statement fit the calendar year if the city government has made provision for a fiscal year differing from the calendar year, but in such cases there is little objection to having the fiscal table cover a period different from the calendar year. So, too, in school statistics, it is usually simpler, and it is the custom, to make use of the school year rather than the calendar year. For statistics relating to communicable diseases, and for vital statistics, as ordinarily understood, it is very important for purposes of comparison with other places, that a calendar year should be used. In every instance where the calendar year is not made use of *it should be plainly stated.*

B. It is an equal convenience to citizens, and to officials in other cities, to find in each report a list of all the officers and employees of the department. It is entirely feasible to print such a list if the city is not too large. If the number of employees is so large that heads of divisions or bureaus are appointed, it will probably not be desirable to print the names of all employees, but merely of the heads of divisions, so that citizens and correspondents may know to whom to apply for information. When this is the case, it is desirable when reporting on the work of each division, to give the *number* of employees, such as inspectors, physicians, nurses, division clerks, etc., employed in each division. On the other hand, in a small town where the selectmen are the board of health with only one health official, all that would be necessary is the name and address, and perhaps office hours, of the health officer.

C. The chief value of the financial statement of a health report is in showing for just what purposes the taxpayers' money is expended. Many reports merely give a list of bills paid, which is all right for the auditor, but is pure waste of time and space so far as the health department is concerned. Other reports, while giving the amounts expended for various purposes, classify these in such a way that the report is of little use to any one and not comparable with the financial statements of other cities. The most important functions of the health department are indicated in the

committee's scheme for the general report and the same headings, though not necessarily with exactly the same subheadings, or in exactly the same order, should appear in the financial statement. While it is the purpose of the financial statement to show the cost of the different kinds of public health work, it is recognized that it is very difficult if not impossible to distribute certain expenditures in this way. Hence some of these general expenses have been grouped in the proposed financial statement, under "General Administration." It was found difficult to decide just what expenses should be placed here, and doubtless in some cities some of these items as postage, printing etc., might be distributed among the succeeding headings, but after careful consideration, the arrangement here presented was decided on and, for the sake of uniformity and to promote comparison, it is hoped that it will be generally followed. In most respects the committee's scheme recommends substantially the same distribution of expenses as that recommended by the Federal Census Bureau* except that the latter separates the expenses for publicity and education according to whether they are for the prevention of communicable diseases, the protection of child life, etc. Our committee believe that in most health offices this would be rather difficult and so have suggested placing all such expenses in a single item. The order, too, of Mr. Power's schedule, is slightly different. This committee's form of financial statement was designed to correspond as closely as possible with the usage of the Federal Census Bureau so that bureau may be able easily to utilize local health reports for its comparisons.

It is not by any means difficult or laborious to prepare a financial statement of this kind. By having a card for each heading such as *Postage, Laboratory, School Nurses, Mosquito Extermination*, etc., and, when each bill is paid, or pay roll prepared, entering the amount on the proper card or cards, very little time is consumed. In a city expending $60,000 a year it was found to take not more than six or eight

* See paper by G. L. Powers on Uniform Accounts, etc., published by the Census Bureau, 1912.

hours in a year, and probably nearly as much time would have been consumed in preparing the meaningless sort of statement which usually appears in health reports.

It is often desirable to compare the expenditures of the year with those of the previous year and it is suggested that this table have two columns for this purpose though it is not considered essential. The lines must be spaced farther apart so as the make the table easier to follow and it will then often be necessary to continue it on a second page to which there is no objection.

D. It ought to be possible by a perusal of the health reports of a city to learn the methods employed. It is not necessary, or in the line of economy, to print an extended description each year, but reference should be made to previous reports in which the workings of the department, or any of its divisions, are to be found. The introduction of new procedures, or modification of old ones, should always be noted with fullness and care. This is particularly important in connection with the management of communicable diseases, for the present time calls for a more critical study of these methods than they have ever received.

It is especially important that the prevalence of these diseases, for a series of years, if possible, should be made plain, and for this purpose the committee suggests certain standard tables. The table showing the number of cases and deaths from the different contagious diseases (Table III) should cover at least ten years if the data are available. Better still it should give the figures during the whole period of notification, by years if possible, but certainly by five year periods, as 1891–1895, 1896–1900, etc.

Among matters which it is important to discuss are duration of isolation, methods of maintaining isolation, and rules for determining the duration of isolation, the control of school children in the family, and of wage earners in the family, and the restrictions applied to other members of the family. If definite rules are in force they should be printed in the report for the year when adopted, and perhaps referred to in succeeding reports. The method of dealing with car-

riers, particularly with diphtheria and typhoid fever carriers, should be noted.

Any local outbreaks due to milk, to water, oysters, school attendance, carriers, contact, flies or any other cause, should be carefully reported. If such reports have been published elsewhere, as in a medical journal, it is economical to give merely the salient features and refer to the complete report.

Any wide spread prevalence of disease or change in severity should be noted. Outbreaks of unusual diseases as smallpox, cerebro-spinal-meningitis and poliomyelitis ought to be most carefully reported.

Outbreaks in institutions should be carefully reported.

The amount of bacteriological work should be given and unusual or research work should be described in detail. In referring to diphtheria cultures state whether nose or throat cultures, or both, are taken. So also in examinations for typhoid bacilli, state whether urine or feces, or both, were examined.

Cases of contagious disease *developing* outside of the community and brought in for treatment in hospitals or elsewhere should be included in Tables II and III, as should all cases *developing* in the community though *contracted* elsewhere.

If many cases which developed or were contracted outside of the city are brought into the city, it may often be desirable for epidemiological reasons to show these in a separate table. But such cases should of course be always included in Tables II and III.

Reports of American hospitals for communicable diseases are woefully deficient. It is usually impossible to learn from them even the proportion of cases removed to the hospital for the year of the report, yet such figures should be given not only for the current year but for a series of years. The duration of hospital isolation for living and for dead cases should be given for each disease. This is important for studying the per capita cost of hospital isolation and for the study of "return cases" and many other epidemiological problems. It occasionally happens that a

case discharged from the hospital infects some one in the family when it returns home, thus giving rise to what are called "return cases." The study of these cases, and particularly of the "infecting cases," which cause them, throws much light upon such important subjects as duration of infection, the determination of infectivity, mode of infection, period of incubation, methods of prevention, etc. Every hospital should ascertain with great care the number of "infecting cases" discharged, and should report them fully, together with duration of isolation, condition as to desquamation, mucous or purulent discharges, presence of infecting bacteria and the interval before development of the secondary (return) case. How many American hospitals furnish such data, data which are often clearly shown by many English hospitals? Unless great care is used in searching for these recurrences many of them are sure to be missed.

Cross infection in the hospital ought also to be reported in the same careful manner as the above.

Infection of the staff, physicians, nurses and other employees, should be reported with similar detail.

The prevention of tuberculosis is now occupying much of the attention of health officials and has enlisted much private activity. The proper differentiation of public and private effort and the best lines of direction for efficient work are still matters for study and discussion. Every health report should show definitely just what the municipality is doing in the way of notification, following up of cases, nursing supervision, pecuniary assistance, clinics, day camps, fresh air schools, hospitals, sanatoria, publicity and investigation. It would not be much of an addition to the report, and would greatly assist investigation of the subject, if the work of other agencies than the health department along these lines should be referred to briefly.

It is believed by most that the free distribution of antitoxin is necessary for the successful control of diphtheria. Others think that the municipality should provide a physician to administer the antitoxin. If such is done the report should clearly state the amount distributed, the number

of persons treated and the number immunized, with the results and cost. Any facts bearing on anaphylaxis should be given. If in any city the municipal distribution of other antitoxin or vaccine is undertaken it should be reported on in the same way.

The question as to the efficiency of terminal disinfection is attracting much attention, as is also the question of the utility of such disinfection. The methods in use should be described. If tests of efficiency are made they should be given in detail. The cost of the service should be given in the financial statement. If the official disinfection consists in part in cleansing, such as washing floor, woodwork and furniture, is should be so stated, and it would be desirable to separate the cost of this from the usual routine gaseous disinfection. So, too, the fact, and cost if possible, of steam disinfection should be noted. If anything is done to secure the direct disinfection of typhoid excreta, or if disinfection is done to destroy malarial or yellow fever mosquitoes, or plague vermin, such should be noted and the cost given, separately, if possible. As many believe that the ordinary routine terminal alleged disinfection by formaldehyde is not efficient, and others think that it is not necessary, it seems wise to set down in black and white just what this procedure costs. The number of tenements disinfected for each disease should certainly be given. Some reports give besides this the number of rooms "fumigated," the number of pieces of goods steamed, and the quantity of the different materials used. In order to study the value of terminal disinfection it is desirable that the recurrences of disease after the termination of isolation should be noted. Unless the recurrences are carefully sought for they are likely to be overlooked, and data, unless accurate, are worthless. The interval between the beginning of the disease and the termination of isolation and the recurrence should be given in the report. It should also be stated clearly whether the recurrence is in the family or in another tenement in the dwelling.

E. As regards the prevention of infant mortality conditions are much the same as with the prevention of tuberculosis. It is new work, requires new methods and enlists private as well as public effort. The relative amount of work carried on by public and private agencies varies in different cities. The report should set forth what is being done and by what agency. Details should be given in regard to publicity, distribution of literature, visiting nurses or physicians, day camps, milk stations, baby clinics, talks to mothers, instruction of "little mothers," etc. It is desirable that the cost of these various activities be separated as much as possible. To assist in determining the value of these methods a good table of infant mortality should be presented giving the causes of deaths by age periods, and the deaths by months. The classification numbers used in Table V indicate the diseases which the committee believed ought to be specified. There is no objection to specifying every disease which causes death under one year. In any event it will usually be necessary to continue this table on a second page and to space the lines so that they may be easily followed. It is very desirable that there should be another table giving the deaths under one year and the rate per 1,000 births for each year for at least ten years. This, however, is not prescribed as essential, as is the other table.

F. The reports of school inspection have been properly criticised as often being prepared in a careless and unscientific manner. As was before said, the report should definitely state whether it is for the school year or the calendar year. The former is more convenient for tabulating and is more often used and is, therefore, preferable for purposes of comparison. All the different lines of work should be described, such as general medical inspection, nursing, and special inspection, as by oculists, dentists, neurologists, etc. Methods for securing treatment for conditions found should be described and results given. Tables showing the work of physicians and nurses are necessary and models for such are here given. Of course they can be greatly extended and others added

at the pleasure of local officials. The number of schools in the community should be given and the number of pupils, also the number of physicians, nurses, etc. employed and their salaries.

In tabulating the work of physicians and nurses it is extremely important to distinguish between the *number of examinations* and the *number of pupils examined* and also between the *number of defects* and the *number of defective children*. There is often the greatest confusion in reports as to this, and in every table, and in every other place where figures are used, care should be taken to specify just what is intended. Care should be taken in the use of the words "defect" or "defective children." It is easy to mislead the public by using such terms in connection with such comparatively minor matters as pediculosis and general dirtiness. The proportion of "defective children" can thus be swelled to alarming figures.

H. Probably privy vaults are the nuisances most dangerous to public health. The report should show how numerous they are and what steps have been taken or are being taken for their removal. If action has been taken to render them fly proof, the methods and results should be reported The construction recommended for vaults and privies should be described and the result of attempting to secure such construction should be given. A tabular statement should be given of the number of nuisance inspections made, of the number of formal orders issued and the legal action taken and its results.

Any interesting work in the abatement of important and unusual nuisances such as offensive trades, burning dumps, or stagnant water should be reported. If troublesome problems, such as are presented by the sanitary control of alleys, garbage receptacles, stable manure or chicken-killing establishments, have been partially solved, a statement should be given of what has been done.

I. Great difficulty is usually encountered in attempting to obtain from health reports accurate information in regard to the collection and disposal of municipal wastes and the

cost of the same. It is true that in many cities, perhaps in most, waste collection is not a function of the health department, but in many it is and whenever this is the case citizens and others are entitled to all the facts.

In the first place terms should be made clear. It should be noted whether the term garbage is restricted to kitchen refuse or whether market and store refuse is included. If private collectors (licensed scavengers) collect any considerable amount, it should also be stated. If garbage includes combustible refuse as it does in some cities, or ashes and combustible refuse as in other cities, it should be so stated. It should appear whether the collection is by the municipality or by contract, and if possible the number of wagons, horses and men employed should be given. The amount collected should be given either in cubic yards or tons, the latter preferably. The amount should, if other data are available, *never be given in terms of loads.* In giving the cost, the cost of collection and the cost of disposal should be given separately. Information should be given as to frequency and times of collection, the location of receptacles and length of haul, as all this very decidedly affects the expense. If there is a contract it is well to note with whom it is made and how long it has to run.

If ashes or combustible refuse are collected separately from garbage the facts should be presented with the same detail as to amounts, wagons, men, horses and place of collection, length of haul, contract, etc.

The method of disposal of the different kinds of refuse should be well described, whether by sale (and if so the ultimate disposal), by dumping, by towing to sea, by rendering or by cremating, etc. If cremation or rendering is employed the particular process should, at the time of its introduction, be described in detail and the reference to the description given in succeeding reports.

P. Vital statistics are at once the foundation of sanitary science and the test of sanitary practice. While it is not necessary for small communities to make a detailed study of the data, every town which publishes a health report

should present a table of the causes of death for the year of the report, by ages and sex. This is absolutely essential. It is also essential that this table should be comparable with similar tables in other reports. This fundamental table (Table XIII) as here presented is approved by the officials of the Census Bureau. It is almost as important that the total deaths, the population and the death rate, be given for a series of years. The committee, therefore, recommend as essential Table XII.

Many other tables giving births and deaths by wards, by months, by nativities, parent nativities, etc., would be of undoubted value wherever a more detailed tabulation and analysis is possible, and especially in the larger cities. And for all such cities it is recommended that to the two tables above required, Tables XIV, XV, and XVI be added.

Here in the United States most interesting conditions exist. Many nationalities dwell in the same city and oftentimes in the same ward, yet have different habits of living. Wonderful opportunities are thus afforded for comparing the various peoples, and for learning the dangers peculiar to each. Tables XIV, XV, and XVI, based upon a division of the population by birthplaces of mothers, will permit such comparison of different nationalities in the same city and of each nationality in different cities.

In the tables of deaths must be included every death occurring in the town or city represented by the table. No exception must be made on any pretext whatsoever. If, however, it is desired to show in a separate table, or paragraph, deaths of non-residents, or deaths in institutions, or the deaths in any other special class, there is no objection, but all such must in every instance be included in the tables recommended by this committee. Stillbirths are not to be included in tables of deaths but the death of every child born alive, whether premature or not, even if it lives only a fraction of a minute, must be included.

In communities in which the colored population is considerable, Table XIII may be repeated so as to show all the facts for the whites in one table and for the colored popula-

tion in another table or the white and colored may be shown under each disease on separate lines below the males and females.

Tables of births must include living births only. Still-births are to be omitted.

Annual reports should always contain in their tables all the deaths and births *occurring* during the year, not those *reported* during the year.

Always state whether the population figures are from a census, municipal, state or federal, or estimated. If estimated the estimate should *invariably* be by the arithmetical method as follows: The difference between the last two censuses should be divided by the number of years between the censuses and the quotient added to the last census figures each year until another census is available. For example, the interval of $4\frac{23}{24}$ years between the Massachusetts State Census May 1, 1905, and the Federal Census April 15, 1910, necessitates adding to the last census population of a Massachusetts city, in order to get the July 1, 1913 estimate, the result of the following:

$$\frac{\text{1910 Pop.} - \text{1905 Pop.}}{4\frac{23}{24}} \times 3\frac{5}{24}.$$

If, however, an addition is made by annexation, the population of the annexed territory should be added at the time of annexation and the number and date should be given in a footnote.

TABLE I.

FINANCIAL STATEMENT.

Receipts.	1911.	1912.
Appropriations.		
Other Receipts.		
Total.		
Expenditures.		
General Administration.		
Salaries, executive officers.		
Salaries, executive clerks.		
Publishing annual report.		
Other printing than above.		
Other binding than above.		
Additions to library.		
Office supplies.		
Telephones and telegrams.		
Postage.		
Rent, water, heat, etc.		
Other expenses.		
Registration of Births, Marriages and Deaths.		
Laboratory.		
Science and Education.		
a. Research.		
b. Publicity and education.		
Prevention of Communicable Diseases.		
Hospitalization.		
Maintenance of hospital.		
Payments to other towns.		
Prevention of tuberculosis.		
Control of outbreaks of smallpox, etc.		
Supervision of cases.		
Visiting nurses.		
Vaccination.		
Antitoxin and its administration.		
Payments for loss of wages.		
Disinfection.		
Maritime quarantine.		
Other expenses.		
Pest Extermination.		
Flies.		
Mosquitoes.		
Rodents.		
Prevention of Infant Mortality.		
Protection of Child Life.		
School physicians.		
School nurses.		
Dental inspection.		
Other school inspection expenses.		
Other expenses for the protection of child life.		
Food Protection.		
Milk and dairy protection.		
Prevention of food and drug adulteration.		
Inspection of meat and groceries.		
Inspection of slaughter houses.		
Inspection of bakeries.		
Inspection of restaurants and hotels.		
Other food inspection.		
Other Direct Health Protection.		
Refuse Removal.		
Garbage.		
Collection.		
Disposal.		
Ashes.		
Collection.		
Disposal.		
Combustible waste.		
Collection.		
Disposal.		
Dead animals.		
Night soil.		
Nuisance Prevention.		
Smoke Prevention.		
Inspection for Protection of Persons and Property.		
Tenement houses.		
Lodging houses.		
Plumbing.		
Other inspection.		
Other Expenses of Department.		

TABLE II.

CASES AND DEATHS OF DISEASES DANGEROUS TO THE PUBLIC HEALTH BY MONTHS.

This table includes ALL cases (with their deaths) irrespective of whether cases were transported into the city from elsewhere or were contracted outside of the city.

Months.	Diphtheria.		Scarlet Fever.		Typhoid Fever.		Measles.		Whooping Cough.		Smallpox.		Ophthalmia Neonatorum.		Poliomyelitis.		Tuberculosis.						Total for Month.	
																	Pulmonary and Miliary.		Meningeal.		Other forms.			
	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
January.																								
February.																								
March.																								
April.																								
May.																								
June.																								
July.																								
August.																								
September.																								
October.																								
November.																								
December.																								
Totals.																								

TABLE III.

CASES AND DEATHS OF CERTAIN DISEASES. EACH YEAR FOR TEN YEARS.

This table includes ALL cases (with their deaths) irrespective of whether the cases were transported into the city from elsewhere or were contracted outside of the city.

Years.	Diphtheria.		Scarlet Fever.		Typhoid Fever.		Measles.		Whooping Cough.		Smallpox.		Ophthalmia Neonatorum.		Poliomyelitis.		Tuberculosis.					
																	Pulmonary and Miliary.		Meningeal.		Other Forms.	
	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
1903.....																						
1904.....																						
1905.....																						
1906.....																						
1907.....																						
1908.....																						
1909.....																						
1910.....																						
1911.....																						
1912.....																						

The above listed diseases are among the more prevalent which are required to be reported by the State Board of Health in Massachusetts. In other places a somewhat different list may be more useful.

Each of these tables might well be spread over the greater part of page.

TABLE IV.

REMOVAL OF CASES TO HOSPITAL FOR CONTAGIOUS DISEASES.

Year.	Scarlet Fever.		Diphtheria.		When numbers warrant, specify other diseases or combinations of diseases.	Other Diseases.	
	Cases Removed	Deaths.	Cases Removed.	Deaths.		Cases Removed.	Deaths.
1903							
1904							
1905							
1906							
1907							
1908							
1909							
1910							
1911							
1912							
Totals							

TABLE V.

INFANT MORTALITY.

Year 19.....	Total deaths under 1 year.	Ages. Under 1 day.	1–2 days.	2–3 days.	3 days — 1 week.	1–2 weeks.	2–3 weeks.	3 weeks — 1 month.	1–2 months.	2–3 months.	3–6 months.	6–9 months.	9–12 months.
January													
February													
March													
April													
May													
June													
July													
August													
September													
October													
November													
December													
Male													
Female													
White													
Colored													
Classification Number.													
1													
5													
6													
7													
8													
9													
10	(The titles corresponding to these numbers are to be inserted here.)												
14													
18													
19													
20													
24													
28													
29													
30													
31–35													
36													
37													
38													
61													
61a													
63a													
71													
76													
79													
89													
91													
92													
93													
103													
104													
108													
109													
117													
119													
143													
144													
145													
150a													
b													
c													
151a													
b													
152a													
b													
167													
168													
172													
182–184													
187–189													
	Other causes												
	Totals												

TABLE VI.

SCHOOL PHYSICIAN'S REPORT.

Diseases.	Cases.*	Result.	
		Improved.	Not improved.
Diphtheria			
Scarlet fever			
Measles			
Tonsilitis			
Tuberculosis			
Other contagious diseases			
Suspected contagious disease			
Anæmia			
Diseases of the digestive system			
Diseases of the ear			
Defects of hearing			
Diseases of the eye			
Defects of vision			
Diseases of the circulatory system			
Diseases of the nervous system			
Diseases of the respiratory system			
Pediculosis			
Scabies			
Other diseases of the skin			
Defective teeth			
Orthopedic cases			
Tonsils and adenoids			
Totals			

Vaccinations.....
Number of pupils examined.....
Number referred to family physician.....
Number sent to hospital or dispensary.....

*Refers to number of diseases, not to number of children. Several diseases may be found in one child.

TABLE VII.

SCHOOL NURSE'S REPORT.

Diseases.	Cases.*	Result.	
		Improved.	Not improved.
Defective teeth			
Defective vision			
Other diseases of the eye			
Defective hearing			
Other diseases of the ear			
Diseases of the digestive system			
Diseases of the circulatory system			
Diseases of the nervous system			
Diseases of the respiratory system			
Impetigo contagiosa			
Ringworm			
Pediculosis			
Scabies			
Other diseases of skin			
Orthopedic cases.			
First aid			
Wounds			
Totals			

Number of children examined.....
Number referred to school physician.....
Number taken to hospital or dispensary.....
Number treated at home.....
Number of home visits.....

Make it evident whether "Number of children examined" refers to number of individuals examined or number of examinations made.

*Refers to number of diseases, not to number of children, several diseases may be found in one child.

TABLE VIII.

MILK INSPECTION—GENERAL STATISTICS.

	1908.	1909.	1910.	1911.	1912.
MILK INSPECTION—CITY.					
Samples, milk and cream for chemical analysis					
No. found below grade					
Percent below grade					
Samples, milk and cream for bacteriological analysis					
No. above 500,000 bacteria per cc.					
Percent above 500,000 bacteria per cc.					
Temperatures of milk and cream taken					
No. found above 50° Fahrenheit					
Percent above 50° Fahrenheit					
INSPECTIONS.					
No. of depots and stores handling milk					
No. of inspections made					
No. of re-inspections made					
No. found contrary to regulations					
No. of inspections of wagons					
Average no. of inspections per store					
LICENSES.					
No. of Licenses for depots issued					
No. of Licenses for stores					
No. of Licenses for wagons					
No. of Licenses refused					
No. of Licenses revoked					
MILK INSPECTION—COUNTRY.					
No. of farms supplying milk and cream					
No. of farm inspections (not scored)					
No. of farm inspections (scored)					
No. of re-inspections (not scored)					
No. of re-inspections (scored)					
Total inspections of all kinds					
Average no. of inspections per farm					
Average score of farms					
Contagious disease investigation					
LEGAL CASES.					
Suits instituted.					
Convictions					
Pending					
Fines imposed					
MISCELLANEOUS MILK DATA.					
Total daily supply, gals.					
Per cent. of milk pasteurized					
Average price of milk, winter					
Average price of milk, summer					
Letters or orders sent					

If some of the information called for in this table is not available, the items that cannot be filled are to be omitted.

TABLE IX.

CLASSIFICATION OF DAIRY FARMS INSPECTED DURING FIVE YEARS ACCORDING TO SCORES.

	1907.		1908.		1909.		1910.		1911.	
	No.	%.	No.	%.	No.	%.	No.	%.	No.	%.
Scoring below 31										
Scoring 31 to 40										
Scoring 41 to 50										
Scoring 51 to 60										
Scoring 61 to 70										
Scoring 71 to 80										
Scoring 81 to 90										
Scoring 91 to 100										
Total No. of Dairies Inspected										
Average Score All Dairies										

TABLE X.

RESULTS OF BACTERIOLOGICAL EXAMINATIONS OF MILK (YEAR).

Bacteria per cubic centimeter.	Samples from wagons.		Samples from stores.		Samples from depots.	
	No.	%.	No.	%.	No.	%.
Below 10,000						
10,000 to 20,000						
20,000 to 50,000						
50,000 to 100,000						
100,000 to 500,000						
Total samples under 500,000						
500,000 to 1,000,000						
1,000,000 to 5,000,000						
5,000,000 to 10,000,000						
Above 10,000,000						
Total samples above 500,000						
Grand total of samples						

TABLE XI.

NUMBER OF { TONS / CU. YARDS } OF GARBAGE, ASHES AND COMBUSTIBLE WASTE COLLECTED, WITH COST OF COLLECTION AND DISPOSAL OF EACH.

GARBAGE.

Total Amount, Tons or Cu. Yards.	Method of * Disposal.	Receipts.	Cost of Collection.	Cost of Disposal.	Net Cost of Both.

ASHES.

Total Amount, Tons or Cu. Yards.	Method of * Disposal.	Receipts.	Cost of Collection.	Cost of Disposal.	Net Cost of Both.

COMBUSTIBLE WASTE.

Total Amount, Tons or Cu. Yards.	Method of * Disposal.	Receipts.	Cost of Collection.	Cost of Disposal.	Net Cost of Both.

Give all amounts in tons or cubic yards, not in loads.

*State method of disposal, whether by feeding to swine, burning, dumping, etc. If more than one method of disposal, so state, giving amounts of each.

TABLE XII.

BIRTHS, DEATHS, STILLBIRTHS AND PERSONS MARRIED, WITH POPULATION AND RATES PER 1,000 OF POPULATION.

Year.	Population.* Estimated July 1st.	Births (Stillbirths excluded).	Deaths (Stillbirths excluded).	Stillbirths.	Persons Married.	Rates per 1,000 of Population.		
						Birth Rate.	Death Rate.	Persons Married, Rate.
1903.								
1904.								
1905.								
1906.								
1907.								
1908.								
1909.								
1910.								
1911.								
1912.								

* Census populations were in 1900.....
1905.....
1910.....

July 1st populations estimated by the arithmetical method as described on page 614.

This table might well be spread over a larger part of the page.

TABLE XIII.

DEATHS CLASSIFIED BY SEX,

EXCLUSIVE

Class. No.	Cause of Death.	All Ages.	Under 1 year.	1.	2.	3.	4.	5–9.	10–14.	15–19.	20–24.
	All causes.	Total Male Female									
1.	Typhoid Fever	123	M. 73 F. 50								
6.	Measles (etc.)	4	M. 2 F. 2								
	(Causes which show no deaths for the year may be omitted.)										

TABLE XIII.—*Continued.*

BY AGE AND BY CAUSE.

OF STILLBIRTHS.

25–29.	30–34.	35–39.	40–44.	45–49.	50–54.	55–59.	60–64.	65–69.	70–74.	75–79.	80–84.	85–89.	90–94.	95–99.	100 +	Unk	Class. No.
																	1.
																	6.

TABLE XIV.

POPULATION ACCORDING TO 1910 CENSUS, BY SEX, BY

			All ages.	Under 1 year	1.	2.	3.	4.	5–9	10–14.	15–19.	20–24.
1	Total											
		Males										
		Females										
2	White	Total										
		Males										
		Females										
3	Colored	Total										
		Males										
		Females										
	For whites only. Mothers born in											
4	United States	M										
		F										
5	Ireland	M										
		F										
6	Germany	M										
		F										
7	England & Wales	M										
		F										
8	Canada	M										
		F										
9	Scandinavia	M										
		F										
10	Scotland	M										
		F										
11	Italy	M										
		F										
12	France	M										
		F										
13	Hungary	M										
		F										
14	Bohemia	M										
		F										
15	Russia	M										
		F										
16	Poland	M										
		F										
17	Other Foreign	M										
		F										
18	Unknown	M										
		F										

TABLE XIV.—*Continued.*

AGE, BY COLOR AND FOR WHITES BY BIRTHPLACE OF MOTHER.

25–29.	30–34.	35–39.	40–44.	45–49.	50–54.	55–59.	60–64.	65–69.	70–74.	75–79.	80–84.	85–89.	90–94.	95–99.	100 +	Unk	
																	1
																	2
																	3
																	4
																	5
																	6
																	7
																	8
																	9
																	10
																	11
																	12
																	13
																	14
																	15
																	16
																	17
																	18

TABLE XV.

DEATHS CLASSIFIED BY CAUSE, BY SEX, BY COLOR,

EXCLUSIVE

Abridged List, Class No.	Abridged list. Causes of Death.		Total.	Whites.	Colored.	For whites Birthplaces of									
						United States.	Ireland.	Germany.	England and Wales.	Canada.	Scandinavia.	Scotland.	Italy.	France.	Hungary.
	All Causes	Total													
		Males													
		Females													
1	Typhoid fever	M													
		F													

TABLE XV.—*Continued.*

BY MONTH AND FOR WHITES BY BIRTHPLACE OF MOTHER.

OF STILLBIRTHS

only. Mothers.																	
Bohemia.	Russia.	Poland.	Other Foreign.	Unknown.	January.	February.	March.	April	May.	June.	July.	August.	September.	October.	November.	December.	Abridged list. Class No.

TABLE XVI.

DEATHS CLASSIFIED BY SEX, BY AGE, BY COLOR, AND

EXCLUSIVE

			All ages.	Under 1 year.	1.	2.	3.	4.	5–9	10–14.	15–19.	20–24.
1	Total											
	Males											
	Females											
2	White	Total										
		Males										
		Females										
3	Colored	Total										
		Males										
		Females										
	For whites only. Mother born in											
4	United States	M										
		F										
5	Ireland	M										
		F										
6	Germany	M										
		F										
7	England & Wales	M										
		F										
8	Canada	M										
		F										
9	Scandinavia	M										
		F										
10	Scotland	M										
		F										
11	Italy	M										
		F										
12	France	M										
		F										
13	Hungary	M										
		F										
14	Bohemia	M										
		F										
15	Russia	M										
		F										
16	Poland	M										
		F										
17	Other Foreign	M										
		F										
18	Unknown	M										
		F										

TABLE XVI.—*Continued.*

FOR WHITES BY BIRTHPLACE OF MOTHER.

OF STILLBIRTHS

25–29.	30–34.	35–39.	40–44.	45–49.	50–54.	55–59.	60–64.	65–69.	70–74.	75–79.	80–84.	85–89.	90–94.	95–99.	100 +	Unk.	
																	1
																	2
																	3
																	4
																	5
																	6
																	7
																	8
																	9
																	10
																	11
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																	15
																	16
																	17
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BOOK REVIEWS

The Sources and Modes of Infection. *By Charles V. Chapin, M. D., Sc. D., Superintendent of Health, Providence, R. I., author of "Municipal Sanitation in the United States." Second edition revised and enlarged. Small 8vo., xi, 481 p. $3.00 net (12/6 net). New York: John Wiley & Sons. London: Chapman & Hall, limited, 1912.*

When the first edition of Doctor Chapin's "Sources and Modes of Infection" appeared three years ago its conclusions seemed a little radical to many practical workers in the field of public health. Gradually, however, the wealth of evidence presented has carried conviction to the most skeptical and the wide influence exerted by the work is indicated by the fact that a new edition has been called for in a little over two years. Doctor Chapin's book is so familiar to us all that it seems only necessary to call attention to the specific additions which have been made to the first edition. In the aggregate they are considerable, involving the addition of 80 pages, an increase of 20 per cent. in the size of the book.

In Chapter I, on the Life of Disease Germs Outside of the Body, there are only minor changes, including reference to the demonstration by Ruediger and Houston, that typhoid germs live longer in cold than in warm waters and to the work of Gorham and Pease on the hibernation of oysters and their probable freedom from infection in the winter months. Chapter II, on Carriers and Missed Cases, includes the largest amount of new material, being half again as long as in the old edition. In connection with typhoid fever are noted the new facts as to the persistence of typhoid baculi in the gall bladder with consequent intermittent discharge, the data in regard to the percentage of temporary and chronic carriers and carriers among a normal population, the facts which have accumulated as to the length of persistence of carrier infection and the many striking epidemics due to carriers which have been worked out in Washington and New York and in New England. Recent English and German data in regard to the spread of paratyphoid fever by carriers are cited, with French and German data in regard to the distribution of cholera in a similar way. The work of Wickman, Flexner and others in poliomyelitis, which adds a new disease to the list of those probably spread by carriers, is discussed and the chapter ends with a new and admirable summary of the whole carrier problem.

Chapters III (Limitations to the Value of Isolation) and IV (Infection by Contact) are practically unchanged. Chapter V (Infection by Fomites) includes new facts which have accumulated in support of Doctor Chapin's position that ordinary room disinfection is of little sanitary value. Disinfection has now been abandoned in Providence after scarlet fever as well as after measles and the ratio of secondary cases for six years with disinfection was 1.52 and for four years without was 1.61. Comparative figures for diphtheria show in Providence, without disinfection, a ratio of recurrences of 1.64 and in Baltimore, with disinfection, a ratio of 1.76. A new paragraph is added on school disinfection emphasizing the dictum of Hope that "all evidence points strongly to the fact that when children contract infectious disease in school the channel of infection is not by means of school desk or floor but by the personal infection of another child." This word of caution is particularly needed in view of the active campaign being carried on by certain disinfectant firms for there can be no doubt that money now spent on school disinfection could far better be applied to increasing the efficiency of medical inspection.

Chapter VI (Infection by Air) includes a new paragraph on the possible spread of poliomyelitis by dust and a reference to the work of the reviewer on streptococci in dust. It should be noted that in the final report on this subject by Kligler and the reviewer which has appeared since Doctor Chapin's book it was pointed out that "it should be understood that these results lend any weight to the theory of what is ordinarily conceived

as the aërial transmission of disease." Disease germs may, perhaps, be carried by "dust inhaled or ingested in considerable quantities," as it is by the mouth spray, but in both cases the pollution is a local and transient one. The experience of modern hospitals of which much that is new is cited by Doctor Chapin, and recent bacteriological studies of school room air in New York have shown that ordinary quiet air must be a wholly insignificant factor in the spread of disease.

Chapter VII (Infection by Food and Drink) contains new paragraphs on water-borne dysentery in our western states and on McLaughlin's study of water-borne diarrhoea, on Hill's damaging criticism of the typhoid epidemic at Ogdensburg, attributed on very dubious evidence to ice and on the recent American milk epidemics of septic sore throat. The most important new material, however, is the analysis of the Mills-Reincke theorum in regard to the part played by improved water in decreasing disease other than typhoid fever. Doctor Chapin points out the great uncertainty involved in deductions from a decrease in the general death rate from all causes and notes that the decreases in deaths from the special causes specifically mentioned by Sedgwick and MacNutt in their study of this subject are not concordant in the various cities cited. Infant diarrhoea decreased more rapidly after filtration in Hamburg and Lowell but not in Albany and Lawrence. Tuberculosis declined no more rapidly in Lawrence and Lowell and Albany after water purification than before. There was a drop in pneumonia in Lawrence but not in Lowell. More recent evidence from Providence, Cincinati, Columbus, Pittsburgh, and Philadelphia does not tend to bear out the Mills-Reincke theory except in regard to diarrhoea at Pittsburgh. Doctor Chapin concludes, "at present it seems unwise to consider the proposition demonstrated and to promise a lowering of the general death rate as a result of the purification of water supplies."

Chapter VIII (Infection by Insects) contains a great deal of new material. The suggested relation between pellagra and Simulium, opilacao and Connorrhinus, papataci fever and oriental sore, and sand flies is briefly discussed and several pages are devoted to the important and fairly conclusive demonstration that typhus fever is spread by the body louse, which so well explains the historical and geographical and seasonal prevalence of this disease. The main additions of this chapter are, however, in the section dealing with the house fly. The impression that this insect may play an important part in spreading disease has been materially strengthened during the last two years by bacteriological studies leading to the isolation of disease germs from the bodies of flies, by English studies of the seasonal coincidence of flies with diarrhoea, by Doctor Hill's studies of fly-borne typhoid in Minnesota, and particularly by the reduction in typhoid fever following anti-fly campaigns in Jacksonville, Richmond and Asheville. Doctor Chapin still preserves a considerable skepticism in regard to this question, a skepticism which seems not quite warranted so far as the conditions in southern cities and in rural districts are concerned. His final summing up, however, which is word for word the same as that in the first edition is still wholly in accord with facts: "It is probable that under certain conditions, as in military and civil camps and in filthy communities without sewerage, insects, especially flies, may be an important factor in the spread of the fecal-borne diseases, but there is no evidence that in a well-sewered city with few privies the house fly is a factor of great moment in the dissemination of disease."

There could, indeed, be no better evidence of Doctor Chapin's soundness and caution than the fact that not one of the general conclusions in the first edition of this work have yet required important modification in the light of subsequent experience. The Sources and Modes of Infection will continue to serve as a safe chart and compass for the scientific and progressive sanitarian.

C.-E. A. Winslow.

The Modern Treatment of Nervous and Mental Diseases. *By eminent American and British authors. Edited by William A. White, M.D., Superintendent of the Government Hospital for the Insane, Washington, D. C.; Professor of Nervous and Mental Diseases in the Georgetown University and in the George Washington University; Lecturer on Mental Diseases in the U. S. Army and U. S. Navy Medical School, Washington, D. C., and Smith Ely Jelliffe, A.M., M.D., Ph.D., Adjunct Professor of Diseases of the Mind and Nervous System in the Post-Graduate Medical School and Hospital; Visiting Neurologist to the City Hospital; Consulting Neurologist to the Manhattan State Hospital, New York, N. Y. Two octavo volumes, containing about 900 pages each, illustrated. Per volume, cloth, $6.00 net. Lea & Febiger, Publishers, Philadelphia and New York, 1913.*

This exceedingly interesting and important work brings together the views of not only the sociologist, pedagogist and criminologist, but also the neurologist and psychiatrist. Of special interest to health officers, and particularly medical officers of schools, are the chapters upon education, feeble-mindedness and mental hygiene.

The chapter on education by Doctor Colvin illustrates clearly the development of fundamental instincts and recognizes their close relation to learning and education, demonstrating the factors that are lacking in feeble-minded and retarded children. He refers to conduct and behavior as the fundamental factors upon which the child's future is based.

Doctor Goddard, in the chapter on educational treatment of the feeble-minded, furnished, in a concise and excellent manner, the meaning and causes of feeble-mindedness and follows the same by a complete outline of the Binet-Simon measuring scale of intelligence. Under the principles of training he includes memory, reproductive and constructive imagination. He refers also to the necessity of "doing things" with an incentive. Activities must be pleasant from the beginning, hence frequency of change and the bringing in new interests must be associated with the correction of faulty mental habits.

The chapter on delinquency and crime by Doctor Healy refers briefly to the fundamental causations of criminality and also to the many conditions under which the child may become a public charge. He recommends well-adapted stimuli and the creation of new interests in dealing with the rationale of treatment in the juvenile offender. The right companion at the right time, the correct explanation of bothersome thoughts, and the development of healthy mental trends are definite guides to success.

Doctor Salmon, writing upon immigration and the prevention of mental diseases concludes by saying that the pressing need is not for better immigration laws or for facilities for enforcing them, but a sufficient number of medical officers trained in psychiatry, for sufficient interpreters and for adequate and sanitary detention quarters in all parts.

The remaining chapters are devoted to interesting expositions upon treatment of the various types of psychoses.

The work is a very valuable one and the latest and best on the subject.

Frederic J. Farnell, M.D.,
Providence, Rhode Island.

The New York Charities Directory. *Published by the Charity Organization Society of the city of New York. United Charities Building, 105 East 22d Street, New York. 865 pp. octavo, cloth bound, $1.00.*

The twenty-second (1913) edition of the New York Charities Directory which has just been published is an indispensable guide and reference book to any one engaged or interested in social, civic, religious and charity work. The presence of this book on one's desk will be found of great value. The vast amount of material contained in the Directory is well organized and classified. The information is presented under the headings of the following nine classes: Class I, Care and Relief of the Needy in Their Homes; Class II, Relief for Destitute, Neglected and Delinquent Children; Class III, Relief in Permanent and Temporary Homes for Adults; Class IV, Relief for the Sick; Class V, Tuberculosis Prevention and Relief; Class VI, Relief for the Defective; Class VII, Treatment of Delinquent Adults; Class VIII, Preventive Social Work; Class IX, Supervisory and Educational Work.

There is an index by names and also by organizations. A most useful book!

HEALTH DEPARTMENT REPORTS AND NOTES.

TO STATE AND MUNICIPAL HEALTH OFFICERS.

This new division of the Journal is specially designed to be of use to active Health Officers of the countries represented in the American Public Health Association. It will be unable to serve its true function unless the Health Officers are willing to coöperate by sending to the Journal copies of their reports, bulletins, new ordinances and personal information which will be of general interest. Furthermore it would be distinctly desirable if communications on subjects of general interest are submitted for publication in this division of the Journal. The management will further welcome any suggestions from Health Officers for the improvement of this division. All communications should be addressed to Selskar M. Gunn, Managing Editor, American Journal of Public Health, 755 Boylston St., Boston, Mass.

REPORTS.

Seattle, Washington.

Doctor J. E. Crichton, the Commissioner of Health, presents an interesting report for 1911. He states that the year 1911 has proven to be one of the most successful years in health work.

A full discussion of the death rate of Seattle is given which leads Doctor Crichton to the conclusion "that the city of Seattle was not only the most healthful city in the United States in 1910, but was the most healthful city in the entire world." The population of Seattle in 1910 was 237,194. The death rate for 1911 was 8.87 per 1,000. The deaths under one year per 1,000 births was 79.

An interesting and serious situation arose in November 1911 when the great conduits, which bring the water supply to the city were swept away by a severe flood leaving only 100 million gallons of water in the reservoirs which was quickly used up. This made it necessary for the city to pump water into the mains "from sources absolutely dangerous." The department quickly devised methods of rendering the water safe, by black headline artfcles in the papers several days before the water was turned on, which advised the people to boil the water. Packages of chloride of lime were also sent to the dairy men using this water with instructions for its application so that the water would be safe to use in washing cans, pails, etc. Sixty thousand circulars were distributed in the homes of the people, advising them to boil the water or use chloride of lime. Finally when the break in the conducts was repaired and the regular supply turned on again the entire system of mains was flushed out by the Water Department. No Typhoid Fever followed this water famine. Doctor Crichton points out that that which assisted the Health Department more than all other factors combined was the fact that the people seemed to believe in the department and to realize that nothing was being covered up. The circular which was distributed was written in a very vigorous style and headed "DANGER" "Water throughout the City is Filled with Disease Bearing Germs."

The garbage collection problem is dis-

cussed. At the time of the report the garbage situation had resolved itself into a semi-municipal collection and complete municipal destruction and disposal. The term "garbage" in Seattle is used to include all wastes and during 1911 about 250 tons were collected daily. Space forbids reference to the interesting section dealing with the Tuberculosis situation.

Many valuable tables are given and the statistics are satisfactory. Tuberculosis caused 301 deaths, Diarrhoea and Enteritis under two years, 55, Typhoid Fever 24, Diphtheria 20, and Scarlet Fever 8.

Jacksonville, Florida.

Doctor C. E. Terry, the Health Officer, adds another excellent report for the Health Department of the City of Jacksonville for 1912. Doctor Terry states that "it is probably quite true that no municipal report involving a record of as much labor and responsibility as that of a health department receives less attention at the hands of those for whom it is intended and whom it most nearly concerns, the citizens, and I cannot but feel that until the average man and woman come to realize that a low death rate is a greater economy than a low tax rate, a community will reap its full measure of reward for efforts directed at health conservation."

The population for 1912 was estimated at 70,194. The crude death rate was 18.1 and the resident death rate 14.8. There was a decrease of 3.3 per 1,000 in the crude rate over 1911 giving the lowest death rate ever recorded for the city.

Two hundred and fifty-one cases of Smallpox were reported and no deaths. Wholesale vaccination was carried out which was followed by a sudden drop in the number of cases reported. Approximately 30,000 people were vaccinated. Doctor Terry's admirable work on Typhoid Fever has been continued. "1911 showed a decrease of 35 per cent over the preceding year in mortality from this cause and the past year shows a still greater reduction of 55 per cent less than last year." There were 18 deaths from Typhoid Fever in 1912 as against 40 for 1911, and 62 for 1910. Doctor Terry states that he feels that the evidence that a large proportion of the Typhoid Fever of Jacksonville was fly borne is now about complete.

Infantile Diarrhoea has been added to the list of reportable diseases. The subject of infant mortality is interestingly discussed.

Those who are interested in the general question of habit-forming drugs will find interesting information on this subject in the report.

The reports of the various inspectors contain much interesting information.

Allentown, Pennsylvania

The President of the Board of Health emphasizes the great importance of the city installing a complete system of house sewerage. He states that it seems incredible that Allentown has escaped the ravages of an outbreak of Typhoid Fever by reason of her neglect in installing house sewerage.

The establishment of a Municipal Hospital for contagious diseases is announced. The Health Officer, Doctor N. C. E. Guth, presents a short report in which he emphasizes the value of placarding houses in which there is a case of Typhoid Fever. One hundred and seventy-three cases of Typhoid Fever with 14 deaths are reported in the city, the population of which is given at 58,000. An alphabetical list of the causes of death is given which is unusually unsatisfactory. The death rate is not given.

The financial statement indicates that the Board of Health expended $16,638.38, this including the collection and disposal of garbage.

DEPARTMENT NOTES.

Ice Cream.

Attention is called to the fact that supervision of the ice cream supply of most communities has been sadly neglected. This has been the case in many communities where a determined effort has been made to improve the milk and cream supply, and also in communities where the regulations of the far less important articles, butter and cheese, has been agitated. When we consider the wide use that is made of ice cream as a food for invalids and children, in addition to the wide use that is made of it as a refreshment, it is hard to account for the neglect of the proper supervision of this article of food, except for the sole reason that sufficient thought has not been given to the subject.

It is generally recognized that a large amount of ice cream is made from milk and cream that are in such a condition that no health board would allow them to be sold as milk and cream. It is also well known that ice cream is usually thickened with starch, gelatin or vegetable jellies, so that it will not soften readily and so that it may be kept for long periods of time, and also so that only a small amount of cream is necessary to give the proper consistency.

Ice cream is oftentimes manufactured in filthy basements, and it usually contains millions of bacteria per cubic centimeter, some of which are often streptococci and gas-producing organisms. The proper color is sometimes obtained by the use of coal-tar dyes.

There are many cases on record in which impure ice cream has caused ptomaine poisoning and intestinal disorders of various kinds. The development of ptomaine poisoning in ice cream is entirely prevented by the use of pure, sanitary raw products, manufacturing the ice cream in perfectly clean surroundings, and disposing of it within a reasonable time after manufacture. The sooner ice cream can be consumed after it is made the better.

The public cannot be expected to take an active interest in the quality of the ice cream that it purchases until a campaign of education is started by the health authorities. The general impression seems to be that as long as the ice cream is frozen all harmful bacteria must be killed, but we know that this is far from being the case.

Boards of Health should aim to secure a supply of ice cream (1) that is manufactured from milk and cream that are of good quality, (2) that is manufactured in clean, light, well ventilated, sanitary establishments and (3) that is free from adulteration, especially of the injurious kind.

The proper regulation of the ice cream supply of any community involves a large amount of inspection work, both of dairies and of manufacturing plants, and a large amount of analytical work. By the adoption of proper plans for publicity work the coöperation of the public can be secured, and a much more rapid improvement in the ice cream supply can be obtained than by the long and costly method of improvement by legal means.

The importance of the ice cream supply of a community as a possible carrier of infection should be recognized, and it is hoped that the suggestions herein advanced may be the means of causing more attention being paid to this matter in the future than in the past.

C. H. Wells, Health Officer, Montclair, N. J.

Is "Bob Veal" Poisonous?

Laws which are in force in various countries, notably in the United States, forbid the sale of veal under one month of age for use as human food. There is a wide-spread belief that bob veal, as the flesh of these very young calves is popularly called, has properties detrimental to health. It is well known that the flesh of younger animals is richer in water and more tender than that of older ones of the same species. The proportion of the nutrient substances increases with age. Older animals, likewise, yield more of the extractive bodies; so that soup prepared from veal is by no means comparable with that yielded by the meat of fattened cattle. Veal is commonly regarded as

more difficult of digestion than beef, the reason being assigned to differences in the texture of the flesh.

Prof. P. A. Fish of Cornell University has reported a series of experiments in which bob veal was compared with market veal and with beef in respect to some of its properties. Experiments were also carried on in which bob veal was eaten in seven families aggregating twenty individuals ranging from two to sixty years of age. The health of all cases was apparently normal; nor did any family refuse a second helping when another carcass became available. In all veal there is a deficiency of fat as compared with beef. In bob veal this deficiency is naturally somewhat more pronounced, because fat is a result of growth and age under proper nutritive conditions. In the use of bob veal this deficiency may be overcome to a considerable extent by cooking the veal with pork or other fat. Professor Fish is of the opinion that bob veal is in no way injurious when used as human food. The desirability of changing the present regulations and existing legal restrictions regarding the sale of very young veal is thus thrown open for discussion, says the *Journal of the American Medical Association* for March 15. The subject is one which should not be dismissed or settled by a few haphazard experiments or hasty generalizations.

Fly Campaign in 1913.

"During the latter part of the month we will begin our fifth annual campaign against the house fly. This year not only the schools will join, but the Chamber of Commerce and the Department of Public Works will unite with the citizens in an annual clean-up week, beginning May 26. The Health Bureau will start this campaign a few days earlier by going into as many public and parochial schools as possible with moving pictures of the fly, and for the distribution of small colored pamphlets relating to the fly and its dangers. The preliminary campaign against the fly was begun at the Child Welfare Exhibit, April 5–12, when 10,000 buttons bearing the picture of a fly and the legend—'Rochester, N. Y., No Flies, Dirt, Disease,' and 10,000 certificates were distributed to those children who were willing to promise to stand for the statements in the certificate.

"A number of thousand fly swats were expected to be distributed to each holder of the certificate, but unfortunately the fly swats were held up somewhere between the point of shipment in Ohio and Rochester because of the flood, and were, therefore, not distributed. These fly swats will be distributed to holders of the certificates on presentation of the certificate.

"In all of this work the bureau was assisted by the Consumer's League Committee of the Woman's Union, and further assistance is promised by the Union in the distribution of the fly swats and pamphlets. The Woman's Union have proposed to distribute prizes for flies trapped or swatted. A number of merchants will make window displays of fly traps and swats during the clean-up campaign. A large fly trap, suitable for restaurants, large kitchens, windows of livery stables, is being made by some of the schools. Any bright boy with mechanical turn of mind may see the trap at the Health Bureau and, perhaps, make some of them for sale.

"This campaign is not only for the cleanliness of Rochester, but this year it is undertaken that we may save our people, especially our children, from a fly-borne disease, infantile paralysis, which threatens us. We earnestly hope that everybody will join in this campaign, not only for a cleaner city but for a city which during the summer shall have none, or at least very few, cases of one of the most terrible of diseases, infantile paralysis."

Rochester *Bureau of Health*, April, 1913.

La Grippe.

"Quarantine is seldom made of grippe patients by health authorities and the families of patients usually observe very little or no care to keep the germ of the disease from themselves or any one else; yet la grippe is highly contagious, and causes annually from 10,000 to 12,000 deaths in the United States—in 1907, it caused 20,000. The largest number of deaths occur in the winter months.

"The bacillus of la grippe is found in the sputum, nasal mucus, and in the bronchial

secretion, the germ growing in the mouth, throat, trachea, or bronchial tubes. Grippe germs sometimes linger in the nose and bronchial tubes of persons who have had the disease for weeks, months, and even more than than a year; and are spread in the same way that the germs of consumption, diphtheria and pneumonia are spread.

"The grippe germ produces a toxin which poisons the body, and causes weakness and depression, which is not often easy to overcome for months. Many physicians assert that la grippe often brings on pneumonia, ear and eye troubles, etc., and too frequently leaves the kidneys, stomach or nervous system in diseased condition.

"La grippe patients should be isolated.

"The hands of a patient, dishes used, clothes (especially handkerchiefs) should be carefully disinfected.

"Patients should be careful to catch nasal discharge and sputum in handkerchiefs or cloths.

"No food which has been in a patient's room should be eaten by anyone else.

"No la grippe patient should kiss anyone.

"On the patient's recovery the room used should be fumigated."

Monthly Bulletin of the Chattanooga Board of Health.

Finger Bowls.

"The Buffalo Health Department has taken steps to rid the city o' brass finger bowls. A recent investigation showed that such bowls were in use in over half of the restaurants and in some of the hotels. Health Commissioner Fronczack said that the brass bowls were insanitary and spread disease, because it was difficult to cleanse them thoroughly. The Health Commissioner did not object to the use of glass bowls if the waiter rinsed the bowl in boiling water after it had been used. The Health Department is to make war against all restaurants and hotels where sanitary laws are not observed."

American Practitioner, April, 1913.

Venereal Diseases Legislation.

The state of Vermont has recently passed an act with regard to the control of venereal disease, which is here reproduced.

"*An Act to Prevent the Spread of Certain Infectious Diseases.*

"SECTION 1. Commencing on the date of the passage of this act the superintendent or other officer in charge of public institutions such as hospitals, dispensaries, clinics, homes, asylums, charitable and correctionable institutions, shall report promptly to the state board of health the name, sex, age, nationality, race, marital state and address of every charitable patient under observation suffering from venereal diseases in any form, stating the name, character, stage and duration of the infection, and, if obtainable, the date and source of contracting the same.

"SECT. 2. Physicians shall furnish similar information concerning private patients under their care, except that the name and address of the patient shall not be reported.

"SECT. 3. All information and reports in connection with persons suffering from such diseases shall be regarded as absolutely confidential, and shall not be accessible by the public nor shall such records be deemed public records.

"SECT. 4. The state board of health shall provide at the expense of the state, facilities for the free bacteriological examination of discharges for the diagnosis of gonorrheal infections, and also shall provide, at cost, vaccines or antitoxins for the treatment of such infections. And said board shall make, at the expense of the state, the Wassermann test or examine smears for the diagnosis of syphilis; and shall furnish the treatment known as 'Salvarsan' or other accredited specific treatment at cost. But such diagnosis and treatment shall not be furnished until the data required for the registration of the case has been furnished by the physician or institution treating the patient.

"SECT. 5. The state board of health shall include in bulletins or circulars distributed by it, information concerning the diseases covered by this act.

"Approved, February 3, 1913."

Sterilization.

"There are at present nine states which, by the force of the law, provide for the sterilization of certain criminals and of the

feeble-minded. Many other states are preparing laws of this kind. The *Bulletin* hopes to see all o the states in the Union adopt this law.

"The operation of vasectomy itself is practically a painless one, and does not, as most members of the laity believe, deprive the individual of his desire or capacity for sexual congress; it simply prohibits his ability to procreate.

"To many, who have given the matter mere superficial thought, the sentimental point of view is uppermost, but a sane, practical view taken outweighs this.

"Many inmates of institutions for the feeble-minded could be kept safely at their homes and help earn their own and their family's living were it not for the opportunity to reproduce their own kind, which such liberty would give them.

"Viewed from every aspect, it will appear the most practical of any plan for the elimination of the criminal and weak-minded strains, causing an uplifting of the race, and a bettering of the nation."

Texas State Board of Health Bulletin, February, 1913.

Ophthalmia Neonatorum.

"The oft-quoted rough estimate that 25 per cent. of the cases of blindness in public institutions for the blind lost their sight through ophthalmia neonatorum is further substantiated by figures given out by the New York State School for the Blind, at Batavia. Of the 166 pupils registered at this institution during the year ending June, 1912, forty-four lost their sight from ophthalmia neonatorum. This is the more deplorable when one considers that this is a preventable disease. The State Department of Health has for the past few years furnished free for use by physicians and midwives a prophylactic solution which, if dropped into the eyes of the infant immediately after birth, will destroy the virus if there has been infection from the discharges of the mother, and it is to be regretted that owing to a reduced appropriation for this purpose we are unable at the present time to furnish the solution to local health officers, but hope to be able to continue the distribution of the outfits by the first of May, when it is expected that funds appropriated by the present legislature will become available."

Bulletin of New York State Department of Health, March, 1913.

Cattle Poisoning.

"An unusual variety of poisoning occurred in a local dairy last week. Salt is used in large quantities by the dairymen to overcome constipation due to feeding certain foods. In the dairy referred to a fresh shipment of salt was received on Friday and feeding from it started the same evening. On Sunday the first symptoms were noticed; the cows being restless with a staggering gait and showing evidence of pain.

"Paralysis of the fore quarters came on early and at one time twenty-four out of a herd of fifty-two were down at one time. Of these fifteen died.

"Constipation, colicky symptoms, increased respiratory movement, and suppression of urine were noted, death being preceded by coma. At no time was fever noted.

"Nothing developed to indicate an acute infectious disease and an investigation as to the cause of the trouble was started with the food. The change from an old to a new supply of salt thirty-six hours before symptoms developed led to its chemical examination with the result that barium chloride was found to be present in large quantities (about 0.8 per cent.).

"Doctor Woolley examined specimens submitted and reported congestion and pigmentation of the spleen (the pigmentation being due to hemolysis), catarrhal enteritis and acute diffuse nephritis.

"Guinea pigs, inoculated with 1 c.c. of saturated solution of the suspected salt, manifested the same symptoms as the cows. Nothing happened in the control pig injected with 1 c.c. of saturated solution of salt of known purity.

"Barium chloride occurs as an impurity in salt but not often in the quantities found in the above case."

Weekly Report of the Board of Health of Cincinnati, Ohio, May 3, 1913.

"Loose" or "Dipped" Milk in New York.

"In view of recent misunderstandings of the proposed action of the Board of Health in regard to the sale of 'loose' or 'dipped' milk, a résumé of the matter may be of service at this time.

"On September 17, 1912, the following resolution, effective on June 1, 1913, was adopted by the Board of Health:

"'Whereas, The interest of the public health requires that milk should be protected from contamination by human agencies and by dust, dirt and flies, and,

"'Whereas, Many of the premises in the City of New York where milk is sold by dipping from cans are grocery stores in which foods and food products and other commodities not in sealed packages are sold in a manner which causes much dust, and,

"'Whereas, The facilities for proper icing, the proper cleansing of utensils, and the proper protection from flies are often inadequate in such stores, many of which are so arranged that the living rooms open directly into the store, therefore, be it

"'Resolved, That after June 1, 1913, the sale of milk dipped from cans will be permitted only in milk stores approved by this department, and for which a permit has been issued, or in places in which foodstuffs, other than milk products, are sold in original packages only.'

"Subsequently, a draft of special rules and regulations, taking up in detail the requirements of this order, was prepared and sent out by the commissioner to a number of associations and individuals particularly interested in this question, with request for consideration and criticism. It should be noted that these rules and regulations were issued only in a tentative form and are still under consideration by the board. Recently there has been considerable discussion of the matter in the newspapers, and no little misapprehension has resulted, some of the papers making the misstatement that these rules and regulations had been actually adopted. This is not the case, and the commissioner intends that the matter shall have full and fair discussion before the new rules are finally formulated and put in force."

New York City Health Department, May, 1913.

What Vital Statistics Should Be.

"Vital statistics are, in short, not vital; they deal with death, not life, with the 'finished product' only of our slack, slipshod methods. They ought to deal, not with the dead, but who they were, and why and how they died, and why they were not saved. Suppose the factory manager merely knew at the end of the year his total product! Suppose that even this piece of information related, not to the way business went last year, but to the way it went five years before! The modern scientific manager must know not just the total product; he must know also all about the product, the kind, the quality, the cost, and why it is not better for the price. The modern vital statistician must know not only the deaths, but why the health department is not stopping them; what its funds are; how they are spent or wasted; what work is being done; how much of value each division does; and all to one end of saving life."—Hill in *Journal-Lancet*.

Texas State Board of Health, February, 1913.

Use of Discarded Bedding for Charitable Purposes.

"An encouraging evidence of the keen interest taken in the various lines of work auxiliary to the general tuberculosis problem, is the request recently made by the superintendent of nurses that bedding and other articles of furniture which are so frequently released by their owners to be destroyed after the occurrence of tuberculosis, might be used instead for the benefit of those in need of and without such articles.

"This was not a new suggestion, as it had been made more than once in the last two years, but hitherto had been disapproved on the ground that such action by the department might be misinterpreted.

"The plan, however, seemed to promise so much assistance to the nurses in their social service work that, following this latest suggestion, the matter was formally laid before

the board of health with the result that it was decided; that bedding and other articles which are in good condition and which are released by the owners to be destroyed after disinfection, may be kept by the department and used for the relief of other needy patients, provided the person from whom such articles are obtained surrenders same with the understanding that they are to be disposed of as the department may decide, and not with the understanding that they are to be fumigated and then destroyed.

"For the present, arrangements for such disposition of these articles must be made by the nurse with the person who surrenders them, and upon her direction they will be returned to the person in need of them. When such a person is not known to a nurse at the time, she may arrange with some other nurse for the proper disposition of such discarded articles."

Communicable News, New York City Health Department, May, 1913.

Smallpox Prevention.

"The following letter from Dr. N. Hayes voices the sentiment of most sanitarians and epidemiologists that have to deal with epidemics of smallpox. It is becoming increasingly evident that it is wrong in principle to tax the community for quarantine measures in case of smallpox when every person may, at but little expense and pain, secure immunity against the disease. If, then, every person may with certainty secure freedom from smallpox, why should those who secure such immunity be taxed to protect those who refuse or neglect to do so? Several states have already abolished absolute quarantine for smallpox, simply requiring a placard to be posted as a warning sign, and all those who choose to have the disease rather than be vaccinated or who are not afraid of the disease may go into such placarded houses at will. Doctor Hayes' letter follows:

"'The quarantine against smallpox should cease after a year's notice to that effect. This would affect the safety only of those opposed to smallpox vaccination. It is childishly sentimental, and does not rise to the dignity of official red-tapeism to continue to nurse these superstitious defectives as we have in the past.

"'Public duty for the common welfare begins where the power of the individual to easily and safely care for himself ends. The anti-vaccination sentiment is maintained by sectarian 'medicine' and their willfully blind and prejudiced retainers. Society has arrived at a stage where it has no right to enforce vaccination nor to quarantine variola cases.

"'The only rational and efficient method to deal with the antivaccinationists is to let them alone with good will and good feeling. It should be plainly set forth to the public from time to time that vaccination is not dangerous if properly done, and the sore arm that is so much dreaded is unnecessary, and is rightly chargeable to the vaccination.

"'Your valued opinion on the proposition would be received as a compliment and a favor.'"

Kansas State Board of Health, Bulletin, March, 1913.

Canned Goods in Bakeries.

"At a meeting of the Board of Health of the Department of Health held April 8, 1913, it was decided that, upon approval by the sanitary superintendent in each case, the secretary should issue to bakers permits allowing them to return condemned canned goods to the wholesalers and thus obtain the rebate to which they are entitled. This action of the board was merely an extension of a privilege which has for some time past been granted to grocers. The action of the board was taken upon a report of the sanitary superintendent which reads as follows:

"'At the present time an arrangement exists whereby grocerymen may return condemned goods to the wholesalers from whom they were purchased in order that rebates may be obtained and financial loss prevented. The Department of Health has never considered it proper to permit this practice in the case of bakers, but recently numerous applications have been received from bakers and bakers' supply houses requesting that a similar privilege be accorded them. I would recommend that this privilege be extended to bakers and bakers' supply houses provided

the following conditions are complied with:

"'1. In each bakeshop there shall be a barrel, box or bin, suitably covered, upon which or over which shall be placed a sign reading as follows: The contents of this barrel, box or bin are unfit for human consumption, are not to be used as such and are to be returned to the persons from whom purchased, for condemnation by the Department of Health.

"'2. Immediately upon opening a case of canned goods, every can in the case must be inspected by the proprietor of the bakeshop or one of his agents, and all swelled cans shall be placed in the receptacle provided.

"'3. The proprietor of the bakeshop must notify immediately the persons from whom he purchased the goods, of the presence of any material for condemnation. This notice may be served upon the salesman of the house, or may be made in writing through the mail.

"'4. If any 'swells' are found in any bakeshop elsewhere than in the receptacle provided for under section 1, it shall be construed that these goods were to be used in the manufacture of foodstuffs, and therefore, action shall be taken against the proprietor of the bakery for having such material in his possession.'"

New York City Health Department, April, 1913.

Rural Health Boards' Problems.

"The lesson of prime importance that is to be drawn from the Canton outbreak of tonsilitis is that even in Massachusetts, where most of the matters pertaining to the public health are well regulated, the question of the rural community and what it can possibly do in an emergency is one not really well solved. It is distinctly to be understood that the number of cases in an outbreak is not a measure of the efficiency of the officers. In general an infection makes its way into the supply of milk or water, and its results after the natural time for the development of the malady will burst forth at once. The mischief is accomplished before it has given any sign of its presence.

"Even in the large cities such outbreaks are not uncommon, but here they are met instantly by the systems that cities are able to establish for themselves. Every case of typhoid, for example, that is reported to the Boston Board carries on the notification card the name of the family milk dealer, and two or three cases from the same supply set in motion the regular machinery which investigates and, if deemed desirable, stops the supply till it proves itself safe.

"When it comes to the country town the whole matter is on a different basis. The health officer may readily be a practicing physician with patients to care for, the health of the town being an occupation for less busy hours. He may or may not have means for testing the presence of bacteria in the specimens that he gathers; he may or may not be in touch with modern methods; he may be progressive or a back number.

"The Massachusetts town health official, as one meets him, impresses one as faithful and sincere. Of his own volition he assembles with fellow-officers three or four times a year to discuss the problems of the work. He receives in common with other members of his company some publications that deal with different aspects of sanitation. But, nevertheless, he is handicapped by conditions that are difficult to meet under existing methods. In a city, notification of disease, which is one of the most practical safeguards, may be reduced to a science, and may be carried by special regulation even beyond the general list set forth by the State. In the country without close attention this strictness may be relaxed.

"Inspection to attain its highest value must be impersonal; in rural districts this is hard to maintain, and, in fact, the farmers are so strong that some products—inspected generally—are sent by them to market uninspected.

"There is then the matter of 'cultures' of disease germs. In a great city if a physician will take his swab to the municipal laboratory he can have the determination in some cases made while he waits. In the country there is the distance to any laboratory, State or private, the bother of mailing and the difficulties of delay. Without question these circumstances militate against prompt determinations and quick action.

"In the light of modern efficiency even the best of rural officers may be working under conditions that are not up to the times, and herein lies the problem of the immediate future. Coöperation is becoming the watchword of the age. There is coöperation in water supply, in sewage disposal, it is lawful in the building of certain public institutions like hospitals, why not then coöperation of rural communities in health administration, dividing the cost and improving the men and the methods?"

The Boston Transcript, May 19, 1913.

The Friedmann "Cure."

"The developments in the deplorable Friedmann affair are bearing out the most pessimistic of the forecasts which accompanied the arrival of the treatment in this country. Open-mindedness has given way to scepticism and the latter to positive condemnation as the indefensible commercialism which surrounds the exploitation has failed to produce trustworthy evidence of clinical value.

"The preliminary report of the Public Health Service at the recent meeting of the National Association in Washington, and published elsewhere in this issue, is none the less damning for its reserve and conservatism; and the resolutions of the association itself represent the practically unanimous conclusion of those in the best position to judge and speak.

"The organized publicity on which the project rested has done its work only too well. The irresponsibility of a large portion of the American press and the psychology of the American people have been exhibited in a discouraging light. The loudly heralded 'boon to humanity' has been turned into a stock-selling scheme and we are now witnessing the spectacle of a scramble for as many of the dollars of despairing consumptives as can be gathered before the inevitable truth premeates the public mind. There is a hasty foundation of 'Friedmann Institutes' in the several states in an endeavor to keep within the law and to take advantage of the brief period of possible profits which still remains. The fact that physicians can be found to lend themselves to this malodorous proposition, while humiliating, should not be regarded as of undue importance. The position of the medical profession, certainly of the leaders, has been for the most part entirely correct throughout. Reserved judgment while reasonable doubt remains is both intelligible and necessary, and it is a cause for congratulation that this has been the general attitude of the profession. The very character, or lack of it, of those who will join in the present promotion may possibly hasten its inevitable end.

"An encouraging sign for the immediate future is the attitude of the daily press. What was at first a prevailing tone of encouragement for the scheme is rapidly changing to one of doubt and even ridicule. This will accomplish more than the united protests of the medical profession, which will certainly from now on be more vigorously made. It is doubtless true that in the few months left before the final word can be given a huge sum can be collected from the proceeds of personal privation and mortgaged homes. From a financial point of view the affair will have been a success. We can only hope that the coming reaction will serve to lend a fresh impetus to the movement founded on the only principles now known which give reasonable promise of results. Perhaps the lesson will have been worth the price."

Editorial, *Journal of the Outdoor Life*, June, 1913.